Maine Center for Disease Control and Prevention
An Office of the Department of Health and Human Services

John E. Baldacci, Governor
Brenda M. Harvey, Commissioner

Department of Health and Human Services
Maine Center for Disease Control and Prevention
286 Water Street
11 State House Station
Augusta, Maine 04333-0011
Tel: (207) 287-5689
Fax: (207) 287-3165; TTY: 1-800-606-0215

May 19, 2009

ICC Technologies, Inc.
Attn.: Harry Bussey, Jr.
240 Boundary Road
Marlboro, NJ 07746

Subject: Product Registration, ICC Technologies, LLC *Flowtech*

Dear Mr. Bussey:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

The ICC Technologies, LLC *Flowtech* consists of a four inch diameter perforated plastic pipe encased in a cylinder. The cylinder is comprised of non-woven geotetextile fabric on the upper 180 degrees and plastic mesh on the lower 180 degrees. The space between the cylinder and the pipe is filled with expanded polystyrene aggregate. The units range from five feet to 20feet in length. Further, cylinders without a central pipe are added to create a bed configuration.

According to the information you provided, the ICC Technologies, LLC *Flowtech* is available in the flowing configurations.

Model	Number of Cylinders	Cylinder Diameter
FTSC 83 H-1	3	8 inch
FTSG 94 H-1	4	9 inch
FTSG 121 H-1	1	12 inch
FTSG 122 H-1	2	12 inch
FTSG 123 H-1	3	12 inch

On the basis of the information submitted, the Division has determined that the ICC Technologies, LLC *Flowtech* is acceptable for use in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions. The *Flowtech* is rated in size as equivalent to a stone trench or a stone bed.

Please note that the installation guide you submitted erroneously refers to approval by a local health department, prior to installation of the system. Rather, in Maine the design is prepared by a licensed Site Evaluator, and a permit to install is issued by the municipality through the Local Plumbing Inspector. The installation guide must be update to reflect this, and a copy submitted to the Department. It is also our understanding from the installation guide that ICC Technologies, LLC requires that *Flowtech* installers be certified by your company.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of ICC Technologies, LLC *Flowtech*. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar or competing products.

If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

Technologies, LLC

April 23, 2009

Maine Dept. of Health and Human Services
286 Water Street, 3rd Floor
11 State House Station
Augusta, Maine 04333-0011
Attn: Mr. James Jacobsen

Dear Mr. Jacobsen,

It was a pleasure talking to you on the phone in reference to approval of our Flowtech™ products.

I have downloaded the application and I am enclosing it along with our 3 ring binder which includes relevant product literature, engineering specifications, studies, and third party certifications.

If there is anything else that you require, please do not hesitate to call me at 732-683-9600 Ext. 103 or e-mail me at hbussey@atlanticbb.net .

Thanking you in advance for your kind consideration to this matter, I am

Very truly yours,

Harry Bussey Jr.

Enclosures

Maine Department of Health and Human Services
Bureau of Health
Division of Health Engineering
Wastewater and Plumbing Control Program

APPLICATION FOR REGISTRATION OF EXPERIMENTAL SYSTEM/INNOVATIVE TECHNOLOGY OR ONSITE SEWAGE DISPOSAL SYSTEM PRODUCT

Please complete the following Sections. Please print or type.

Applicant

Company Name: ___ICC Technologies___

Contact Person: ___Harry Bussey, Jr.___

Address: ___240 Boundary Road___

Town/City: _Marlboro___ State/Province: __NJ__ Zip Code: ___07746___

Country: ___USA___

Telephone: ___732-683-9600 Ext. 103___ e-mail: ___hbussey@atlanticbb.net___

Product

Product Name: ___ICC Flowtech™___

Model: __FTSG83H-1/FTSG94H-1/FTSG121H-1/FTSG122H-1/FTSG123H-1

Product Classification (choose one)

Primary or Secondary Treatment Unit

[ ] Septic Tank [ ] Extended Aerobic Treatment Unit [ ] Recirculating Aerobic Unit

[ ] Aerobic Fixed Film Unit [ ] Other (specify) ___

Effluent Filter

[ ] Septic Tank Outlet Filter [ ] Post-Tank Filter [ ] Other (specify) ___

Disposal Device

[ ] Gravel-less Disposal Pipe [X] Gravel-less Disposal Bed [ ] Chamber, Plastic

[ ] Chamber, Other [ ] Other (specify) ___

Miscellaneous

[ ] Pipe [ ] Effluent Flow Distribution Device [ ] Other (specify) ___

Claim

Describe the product's features (attach additional sheets if necessary).
See binder

Describe the product's performance (attach additional sheets if necessary).
See binder

Has the product received National Sanitation Foundation or Canadian Standards Authority approval?

[ ] No [ ] Yes (If "yes", enclose a copy of the certification.)

IMPORTANT NOTE!

Don't forget to enclose relevant product literature, engineering specifications, studies, and third party certifications with this application.

I, __Harry Bussey, Jr.______________, am the [X] applicant [ ] agent for the applicant of the subject product.
(print name)
I state that the information submitted is correct to the best of my knowledge and understand that any falsification is reason for the Department to deny registration for use of the product in Maine.

__________Harry Bussey, Jr.______________ ______April 22, 2009_____
[X] Signature of Applicant Date
[ ] Signature of Agent for Applicant

ICC Technologies, LLC

ICC Flowtech™

Installation Instructions

For The State Of Maine

ICC FLOWTECH™ LEACHING SYSTEM
INSTALLATION GUIDE
FOR THE STATE OF MAINE

Prior to installation, **ICC Technologies, LLC** must certify installers in writing as having passed **Flowtech™** *Certification Training.* This designation certifies that the installer has passed **Flowtech™** certified training and has been approved.

Equipment needed	**Materials needed**
Backhoe	**Flowtech™** Units
Laser	Barrier Paper/Fabric
Transit	Mesh
Level	Internal Couplings

Installation Instructions

The **Flowtech™** systems may be installed on conventional sites that meet all other criteria **for product standards for gravel substitutes for use in soil absorption systems.** These systems may be sized by ICC Technologies or their representative's.

1. After your local health department has approved size, configuration, and layout for the **Flowtech™** System, mark with paint or stake the location of trenches and lines. Set correct tank, invert pipe, header line or distribution box and trench bottom elevations before installation of **Flowtech™** units.

2. It is recommended, if smearing or glazing of trench sidewalls and bottom has occurred in clay soils, that these soil surfaces be raked or scarified.

3. The trench should be dug to a minimum width of about 12 inches up to a maximum of 36 inches. This not only saves labor in excavation, but also provides better load bearing capacity after backfilling is complete.

4a. Before installing, the **Flowtech™** Leaching System trench should be level in all directions (both across and along the trench bottom) and should follow the contour of the ground surface evaluation (uniform depth), with all continuous adjoining 10-foot cylindrical bundles places end to end, with central bundle distribution pipe interconnected, without any dams, stepdowns or other water stops.

4b. An engineer's level or equivalent shall be used for installation and inspection, when the surface slopes are greater than two percent, the bottom of the nitrification trenches shall follow the contour of the ground.

5. Remove plastic outer bag prior to placing units in the trench(es). Remove any plastic bags in the trench before system is covered.

6. Place **Flowtech™** unit(s) in the **Flowtech™** configuration approved by system design permit specified for the particular site. The top or center-most units containing pipe are joined end to end with an internal pipe coupler supplied. If additional aggregate units with no pipe are required, they should be butted against the other aggregate units with no pipe and do not require any type of connection. Please note, units without pipe should be installed prior to units with pipe in horizontal and triangular configuration.

7. Lead or header lines from distribution box or such device will be connected to the top or center-most **Flowtech™** unit with pipe in each trench.

8. **Flowtech™** EPS units can flex and fit in curved trenches as may be necessary to avoid trees, boulders, or other obstacles in the way.

9. **Flowtech™** products with a "G" preface have 180 degrees of geotextile and 180 degrees of net with flanges. The units should be installed so that the side flanges are bent up, placed in a downward motion along the trench side or the unit already in the trench. These flanges will deter soil from infiltrating between other units or sidewalls when backfilling. The geotextile will act as a barrier to prevent the soil from infiltrating the system and should always be in the up position. For added protection, the installer/designer should consider the addition of approved paper or geotextile.

10. Geotextile units "G" must always have the geotextile in the up position.

11. When installing **Flowtech™** units with pipe off center, always keep the invert of the pipe in the position so as to have 6 inches of aggregate below the invert of the pipe.

12. The soil cover over the leaching field should be at least six inches in depth.

13. A minimum depth of at least 6 inches of soil covering finished grade over leaching field should be adhered to.

14. To prevent the ponding of surface water , soil cover above the original grade should be placed at a uniform depth over the entire leaching field.

15. After proper preparation of original ground surface, soil cover should be placed over leaching field.

Repeat steps 1 thru 15 for each required trench.

THESE INSTALLATION INSTRUCTIONS SUPERCEDE ALL PRIOR INSTRUCTIONS OCTOBER 12, 2007

PRODUCT DESCRIPTION

FOR THE STATE OF MAINE

Following is a description of our products:

1. **ICC Flowtech™ FTSG83H-1 Horizontal Drainage System** consisting of three 8-inch diameter cylindrical unit. One with a 4-inch diameter perforated plastic pipe surrounded by Flowtech™ EPS aggregate and encased with 180 degrees each of netting and 180 degrees of geotextile and two units without pipe. These units will each have flanges so as to deter the soil from falling between units and between unit and trench walls. The geotextile and netting will be strong enough to retain the shape of the units during system installation and backfilling. The perforated flexible plastic pipe shall meet ASTM F 405 Standard Specifications for Corrugated Plastic Pipe. Each pipe unit will be connected with an internal coupling to allow flow from one unit to the next.

2. **ICC Flowtech™ FTSG94H-1 Horizontal Drainage System** consisting of four 9-inch diameter cylindrical unit. One with a 4-inch diameter perforated plastic pipe surrounded by Flowtech™ EPS aggregate and encased with 180 degrees each of netting and 180 degrees of geotextile and three units without pipe. These units will each have flanges so as to deter the soil from falling between units and between unit and trench walls. The geotextile and netting will be strong enough to retain the shape of the units during system installation and backfilling. The perforated flexible plastic pipe shall meet ASTM F 405 Standard Specifications for Corrugated Plastic Pipe. Each pipe unit will be connected with an internal coupling to allow flow from one unit to the next.

3. **ICC Flowtech™ FTSG121H-1 Horizontal Drainage System** consisting of one 12-inch diameter cylindrical unit with a 4-inch diameter perforated plastic pipe surrounded by Flowtech™ EPS aggregate and encased with 180 degrees each of netting and 180 degrees of geotextile. The units will each have flanges so as to deter the soil from falling between units and between unit and trench walls. The geotextile and netting will be strong enough to retain the shape of the units during system installation and backfilling. The perforated flexible plastic pipe shall meet ASTM F 405 Standard Specifications for Corrugated Plastic Pipe. Each pipe unit will be connected with an internal coupling to allow flow from one unit to the next.

4. **ICC Flowtech™ FTSG122H-1 Horizontal Drainage System** consisting of two 12-inch diameter cylindrical units. One with a 4-inch diameter perforated plastic pipe surrounded by Flowtech™ EPS aggregate and encased with 180 degrees each of netting and 180 degrees of geotextile and one unit without pipe. These units will

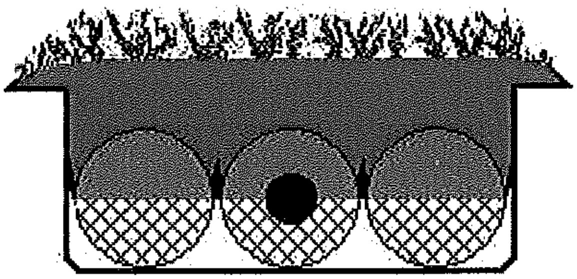
each have flanges so as to deter the soil from falling between units and between unit and trench walls. The geotextile and netting will be strong enough to retain the shape of the units during system installation and backfilling. The perforated flexible plastic pipe shall meet ASTM F 405 Standard Specifications for Corrugated Plastic Pipe. Each pipe unit will be connected with an internal coupling to allow flow from one unit to the next.

5. **ICC Flowtech™ FTSG123H-1 Horizontal Drainage System** consisting of three 12-inch diameter cylindrical unit. One with a 4-inch diameter perforated plastic pipe surrounded by Flowtech™ EPS aggregate and encased with 180 degrees each of netting and 180 degrees of geotextile and two units without pipe. These units will each have flanges so as to deter the soil from falling between units and between unit and trench walls. The geotextile and netting will be strong enough to retain the shape of the units during system installation and backfilling. The perforated flexible plastic pipe shall meet ASTM F 405 Standard Specifications for Corrugated Plastic Pipe. Each pipe unit will be connected with an internal coupling to allow flow from one unit to the next.

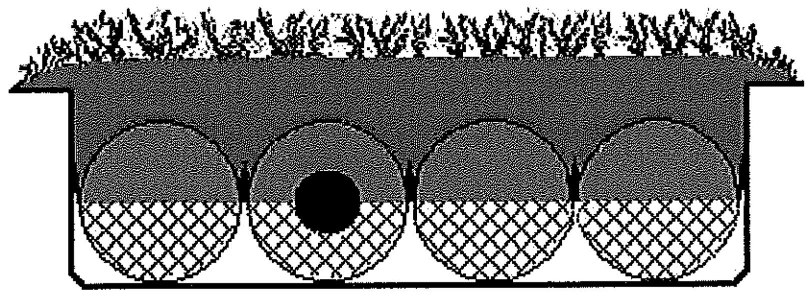
Adding OC to the end of product numbers FTS121H-1, FTSG122H-1 and FTSG123H-1 only, will denote that the pipe is offset with 6-inches of aggregate below the pipe. This offset (OC) is for 12-inches only. The Drainage System utilizes wastewater absorption trenches that contain units of loosely bound expanded polystyrene (EPS) aggregate in place of rock aggregate. The aggregate shall consist of "ICC Flowtech™ aggregate shapes" recycled EPS with a particle density of 1.0 pound per cubic foot, or greater, ranging in size from ½-inch to 2-inches across any axis. When using the product with off center pipe (OC), the unit shall be placed in the trench with 6-inches of aggregate under the pipe.

Cylindrical units ranges from a nominal 8-inches to 12-inches diameter, depending on system configuration. The length of the cylindrical units range from a minimum of 5 feet to a maximum of 20 feet but are usually used in 10 foot lengths. The expanded polystyrene (EPS) aggregate is held in a cylindrical shape with high strength polyethylene netting and geotextile. The netting and geotextile shall be strong enough to retain the shape of the units during system installation and backfilling and of a mesh size to prevent loss of aggregate. At least one cylindrical unit shall contain a perforated flexible plastic pipe for connection to adjacent units to form a continuous absorption field system. The perforated flexible plastic pipe shall meet ASTM F 405, Standard Specifications for Corrugated Polyethylene Pipe. A series of three holes 5/8-inches in diameter spaced 120 degrees around the circumference are located every 4-inches along the lateral length of the pipe. Based on the manufacturer's recommendation, the hole orientation during installation may be random.

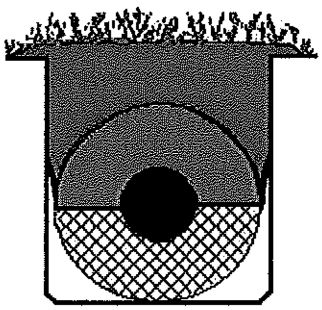
ICC Flowtech™ On Site Drainage Systems for the State of Maine



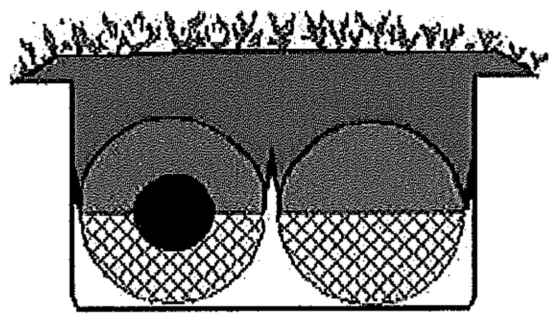
FTSG 83 H-1



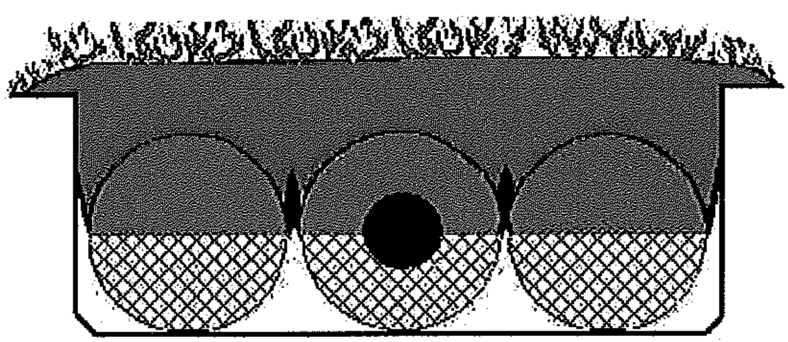
FTSG 94 H-1



FTSG 121 H-1



FTSG 122 H-1



FTSG 123 H-1

ICC Technologies 240 Boundary Road Marlboro, New Jersey 07746
Tel: 1-877-422-3569 Fax: 732-683-9911

Technologies, LLC

The following 2 pages show a picture of the Flowtech™ System packaged in the shipping bag. The bag protects the product in shipping and handling , right to the installation sight. The bag is protected with UV inhibitors. The spec sheet for the bag follows the picture.

Corporate Headquarters: 240 Boundary Road, Marlboro, NJ 07746 • (732) 683-1009 • Fax (732) 683-9911


04/24/2009

TM poly film inc.

PLANT
503 GIL HARBIN IND. BLVD.
VALDOSTA, GA. 31601

PHONE
(229) 247-7734
800-831-2738
FAX (229) 247-5966

April 24, 2009

ICC
240 Boundary Road
Marlboro, NJ 07746

Specifications

Tubing Size: 62" x 1500 ft.

Gauge: 1.5 mil White Opaque

Description: Printed Tubing
3% UVI, Vented

Blend: Chevron Linear Low Density Blend
#7109LT Hexene Copolymer

Thank you,

Jodi G. Hogan
Sales Representative

Technologies, LLC

Table of Contents

Corporate Headquarters: 240 Boundary Road, Marlboro, NJ 07746 • (732) 683-1009 • Fax (732) 683-9911

Engineering Reports – continued

- Unifour Engineering & Testing Laboratories, PC
  Report of Performance Testing for FlowTech™ 12-Inch Drainage Products Under AASHTO H-10 Loading Conditions

- Blackwell Engineering, PLC
  Evaluation of FlowTech™ Drainage Products Under an AASHTO H-10 Load Rating

- Unifour Engineering & Testing Laboratories, PC
  Report of Comparative Evaluation of Drainage Media Hydraulic Properties
  Performance Comparison of FlowTech™ Synthetic Aggregate to Conventional Sand and Gravel Drainage Media

- Unifour Engineering & Testing Laboratories, PC
  Report of Deformation Testing for FlowTech™ Drainage Products Under Direct Vertical Soil Load Conditions

Technical Reports

- StyroChem June 5, 2006
  Properties of Expandable and Solid Polystyrene

- Resirene May 31, 2006
  Properties of Expanded Polystyrene

- Muehlstein May 24, 2006
  Properties of Expandable and Solid Polystyrene

- Blue Diamond February 8, 2007
  AASHTO Testing for 4" Diameter Perforated Corrugated PE Pipe (CPP).

- Blue Diamond July 13, 2007
  ASTM F 405 Specifications

- Conwed January 8, 2007
  Wattle Net

StyroChem®

June 5, 2006

CONFIDENTIAL

Mr. Harry Busey
I.C.C. Technologies
240 Boundary Road
Marlboro, NJ 07746

Dear Mr. Busey:

In answer to your questions concerning the performance of expandable polystyrene:

Termites

- There is no nutritional value in polystyrene and thus it is not attractive to termites, ants, or rodents. Insects will not eat polystyrene, as it is not a food source.
- While termites may burrow through solid polystyrene, for termites it is the same as soil, something in their way, which they will either move or crawl over.

Chemical Absorption

- Polystyrene is an inert, large molecular weight compound that does not breakdown in aqueous solutions.
- Polystyrene does not act as an absorbent like activated carbon, nor is polystyrene very permeable to liquids.

Chemical Degradation

- The chemical resistance of polystyrene is well known. It is not attacked or degraded by long exposures to either bleach, soap solutions, or common household products that are poured down the drain.

StyroChem U.S. • 3607 N. Sylvania Avenue • Fort Worth, Texas 76111 • 817-759-4400 • FAX: 817-759-4460

- Polystyrene is virtually resistant to all aqueous media including dilute acids and bases.

Temperature Stability

- Polystyrene has the ability to tolerate extreme temperature ranges. It has a continuous use temperature range of -108 degrees F + 175 degrees F.
- Polystyrene is not brittle at subzero temperature. Over time polystyrene may soften in boiling water (212 degrees F).
- Products made of polystyrene will not be affected by the harshest of temperature climates or changes.

Life Span

- Expanded polystyrene is a highly stabile compound. The expected life span is indefinite. The product will last for well over 100 years.

Sincerely,

Mike Pate
VP/General Manager
StyroChem US & Canada

Resirene

May 31, 2006

Attention: **Buddy Bussey**
International Cushioning Company, LLC
240 Boundary Road
Marlboro, NJ 07746

Concerning your enquiry about the durability and resistance of expanded polystyrene foam, we can provide the following information:

General Durability and Resistance to Degradation
Polystyrene is a very inert, chemical resistant and biologically resistant material. It is inert to chemical reaction and absorption of essentially all aqueous media. Its only degrading environments are fats, oils and solvents, prolonged exposure to bright sunlight and temperatures above about 170 F.

Undisturbed polystyrene foams exposed to biologically rich soils for many decades exhibit negligible degradation.

Shelf Life
The useful lifetime of polystyrene foam is essentially unlimited, at least many decades, in absence of long-term exposure to sunlight and to fats, oils and solvents.

Termites, Ants and Rodents
Polystyrene can not be digested or metabolized by animals, insects or microorganisms. Hence it is not a source of food and is not consumed by pests. Such pests could presumably burrow through polystyrene foam if there is an incentive such as another food source or shelter to be reached.

Chemical Absorption
The polystyrene foam used for dunnage, insulation and load bearing applications is essentially a closed cell structure. Therefore liquids are unable to permeate and saturate the foam through open channels, as with water in a sponge.

The polystyrene itself which makes up the foam structure is highly inert to the absorption of aqueous media, including acid and bases, and to contaminants that are readily soluble in water. The surface of polystyrene is not strongly active as is charcoal, and therefore remains uncontaminated by organics, salts and trace metals.

Temperature Stability
The use temperature range of polystyrene foam widely exceeds the range of ambient temperatures in all climates. The upper limit for retention of good mechanical properties is about 170 F for prolonged exposure.
There is no significant loss of strength at very low temperatures as with rubbery materials. Therefore polystyrene foam remains a good load bearing and insulting material at far sub-zero temperatures. It is used as an insulating material for cold storage installations at temperatures of about -40 °F.

Hoping that information above will be helpful for your business, please don't hesitate to contact us in case you may need any additional information.

DESC

Paseo de los Tamarindos 400-B Piso 26
Bosques de las Lomas 05120
México, D.F.
MEXICO

Phone: (+52) 55 5261 8000
Fax: (+52) 55 5261 8255
www.resirene.com
www.desc.com

MUEHLSTEIN

May 24, 2006

TO: Mr. Buddy Bussey ~ ICC

FROM: Tom Glasrud

RE: PROPERTIES OF EXPANDABLE AND SOLID POLYSTYRENE

Dear Buddy:

Here is a summary of what we discussed; please let me know if you need further information.

Polystyrene and Insects

Polystyrene resin is not digestible by insects and does not provide them any food source. Because of this polystyrene is widely used for building insulation products and extruded exterior trim. Recently, one company has created composite decking product from PS.

Absorption

Polystyrene is not hydroscopic in nature and does not readily absorb or hold moisture. It is not soluble in any water-based solutions.

Chemical Resistance

Polystyrene holds up well to many common household water-based cleaners (soap, laundry detergents). Polystyrene is degraded and attacked by many industrial solvents (turpentine, mineral spirits, etc.).

Working Temperature

Polystyrene foam products are used in many applications (ice chests, refrigerators, insulation) where temperatures of -20F - +170 deg. F. Polystyrene will soften at temperatures above 200 deg. F.

Degradability and Stability

Polystyrene resin is very stable, high molecular weight polymer; it does not and will not bio-degrade under normal conditions.

T Glasrud

H. Muehlstein & Co. Inc.
800 Connecticut Avenue, Norwalk, CT 06854-1631 Tel: 203-855-6000 • Fax: 203-855-6221

BLUE DIAMOND
Industries, LLC
3399 Tates Creek Road, Suite 110
Lexington, KY 40502
ph (859) 224-0415
fax (859) 224-0543

February 8, 2007

Mr. Buddy Bussey
ICC Technologies, Inc
240 Boundary Road
Marlboro, NJ 07746

Dear Mr. Bussey:

Thank you for your inquiry regarding the open area in Blue Diamond Industries 4" diameter perforated, Corrugated PE pipe (CPP).

You have specified for BDI to provide 3/8" diameter holes drilled at 2.5" c.c. in the 4" pipe. This will provide an open area of approximately 2.66 sq in.

The standard for highway and road drainage in small diameter CPP is set by AASHTO M-252 (The American Association of State Highway and Transportation Officials. AASHTO is the federal body, composed of state department of transportation officials that set standards for interstate and state highways.) The AASHTO minimum value for open area on 4" CPP is 1.0 sq in.

You can see the pipe you are supplying has an open area approximately 260% of the requirement set by AASHTO for highway drainage purposes.

If you require further information please do not hesitate to call.

Best Regards,

George A. Zagorski, PE
Vice President

BLUE DIAMOND
Industries, LLC

PO Box 905
Roseboro, NC 28382
ph (910) 525-5121
fax (910) 525-4934

Corporate Headquarters
3399 Tates Creek Road, Suite 110
Lexington, KY 40502
ph (859) 224-0415
fax (859) 224-0543

July 13, 2007

Attention: Mr. Harry Bussey
ICC
240 Boundary Rd.
Marlboro NJ 28602

Re: Letter of Compliance

Dear Mr. Bussey:

This letter is written to certify the 4" diameter corrugated polyethelene pipe was manufactured in compliance with ASTM F 405 specifications.

Attached is a copy of the laboratory evaluation report. If you have any questions, please do not hesitate to call us.

Sincerely,

Kenny Stafford

Kenny Stafford
QC Manager

Cc: George Zagorski, PE
Vice President

PRODUCT DESCRIPTION SHEET

POLYPROPYLENE 2.1 Cal. 1 Side

PHYSICAL PROPERTIES	TARGET	UNIT OF MEASURE	TOLERANCE
Weight	2.1	oz/yd^2	+/- 10%
Width	90	inches	+1 / -0
Tensile MD	35	lbs.	Minimum
Tensile XMD	40	lbs.	Minimum
Elongation MD	45-65	%	Min – Max
Elongation XMD	45-65	%	Min – Max
Elong @ 15lbs MD	5-20	%	Min - Max
Elong @ 15lbs XMD	5-20	%	Min - Max
Trap MD	13	lbs.	Minimum
Trap XMD	17	lbs.	Minimum

Blue Diamond Quality Control Testing Summary

Manufacturer/Location: Blue Diamond Industries, North Carolina, USA plant
Resin No. : N/A Production No.:N/A
Type: Type CP
Size: 4" (100mm)
Perforation Class:
Specification: ASTM F 405

SECTION	SPECIFICATION	TEST RESULTS
6.1 Basic Materials	Minimum Cell Class 424420C	424420C
	Density 0..940 to .960 g/cm³	.946
	Melt Index 0.15 to 0.40 g/10 min.	.31
	Carbon Black Content – 2- 3%	2.2
	NCLS with 4100 kPa and 20% notched depth for 24 hours	N/A
7.1 Workmanship	Free of foreign inclusions and visible defects. Inner liner shall be fused to outer corrugated wall at all internal corrugation crests.	Pass
7.2 Pipe Dimensions, 7.2.3 Inside Diameter	Nominal inside diameter shall not exceed 4.5% oversize or 1.5% undersize and not more than 37mm oversize. 98 to 105mm (3.86 to 4.13")	3.96
7.3 Perforations	Solid Pipe, Class 2	N/A
	Holes .25" to .75"	.25"
	Inlet area of 20 cm²/m (1.0 in²/ft)	2.65 in2/ft
7.4 Pipe Stiffness	Minimum pipe stiffness requirement at 5% deflection is (30 psi), @ 0° / 45°/ 90°	41/40/37
7.5 Pipe Flattening	No evidence of buckling, cracking, splitting, or delamination, when the vertical inside diameter is reduced by 20%	N/A
7.6 ESCR	There shall be no cracking of the pipe.	Pass
7.7 Elongation	5% or less	3.3
7.7 Brittleness	The pipe specimens shall not crack or split. Five non-failures out of six impacts will be acceptable.	Pass
7.8 Fitting Requirements	Pipe connections shall not separate to create a gap exceeding 5mm (0.197") when measured between the bell and spigot portions of pipe fittings shall not crack or delaminate.	N/A
11 Marking	Pipe and fittings shall be marked at intervals not more than 3.5m (11.5'), manufacturer's name or trademark, nominal size, ASTM F 405, plant code, and date of manufacture of appropriate code.	Pass

Kenny Stafford 7-13-07

Kenny Stafford-Quality Control Manager Date:

TYPICAL PHYSICAL PROPERTIES

VERSARE 2300 NATURAL
100% Polypropylene

Property	*Value*
Weight, oz/sy	2.3 osy
Tensile Strength, MD/lbs.	56
Tensile Strength, CMD/lbs.	55
Elongation at 10 lbs MD%	8%
Elongation at 10 lbs CMD%	12%
Trapezoid Tear, lbs. MD	22
Trapezoid Tear, lbs, CMD	26

2006

Product: RO4010-005
Description: Black 80" x 13000'
Customer: ICC
Date: 3/31/09
Supercedes: New
Originator: Jimmy Wingfield
Customer Approval:______________________

Item	Specified Value	Test Method
Average Weight (lb/1000 sq ft)	5.0 +/-0.5 PMSF	Modified ASTM D3776
Average Strand Count (strands/10")	Strand Count 20.0 +/-2.0 per 10" MD 20.0 +/-2.0 per 10" TD*	Modified ASTM D3775
Average Tensile Strength (lb_f/3") or (lb_f/# strands in 3")	Tensile Strength MD = 40.0 +/-5.0lb_f/ 6 strands TD = 35.0 +/-5.0lb_f/6 strands	Modified ASTM 1682
Color	Black	
Resin	PP	
Manufactured Length	Target 13000'	
Packaging	Full wrap with blue poly.. 8" ID paper core. 0.500" Wall Core length 83". Core tag and roll tag.	
Roll Width	Minimum width 80"	
Splices	3 max. Double sew, sandwich tape edges.	
Nominal Roll Weight	433 lbs	
Roll Diameter	35" Max	

*TDSC may change within 150' of a splice due to machine constraints

STATE OF ALABAMA DEPARTMENT OF

PUBLIC HEALTH

Donald E. Williamson, MD
State Health Officer

April 7, 2009

Mr. Harry Bussey
ICC Technologies, LLC
240 Boundary Road
Marlboro, NJ 07746

Dear Mr. Bussey:

RE: Permit Number ALM0000111 – ICC Technologies
Flowtech Trench Drain Products – FTS-102V-1, FTS-102H-1, FTS-103V-1,
FTS-103H-1, FTS-106V-1, FTS106H-1, FTS123H-1, FTS103T-1

The Division is re-issuing the product permit for the product(s) listed above. Transmitted herein is a final of the referenced permit. Receipt of this permit is acknowledgment of acceptance of the terms of the permit.

Part I contains the performance standards and the sampling requirements, if any. Part II consists of general administrative requirements and Part III contains specific conditions which apply to the installation and use of your product with any onsite sewage system in Alabama.

Should you have any questions, please feel free to contact me at (334) 206-5373.

Sincerely,

Thad Pittman, Director
Onsite Sewage Branch
Division of Community Environmental Protection

TP/ga
Attachment
cc: Area Environmental Directors

The RSA Tower • 201 Monroe Street • Montgomery, AL 36104
P.O. Box 303017 • Montgomery, AL 36130-3017

ADPH

ALABAMA
DEPARTMENT OF PUBLIC HEALTH

STATE-ISSUED PRODUCT PERMIT

PRODUCT: Flowtech Disposal Products
FTS 102V-1
FTS-102H-1
FTS-103V-1
FTS-103H-1
FTS-106V-1
FTS-106H-1
FTS 123H-1
FTS-103T-1

PERMITTEE: Mr. Harry Bussey
ICC Technologies, LLC
240 Boundary Road
Marlboro, New Jersey 07746
732/683-1009

FACILITY LOCATION: State Wide

PERMIT NUMBER: ALM0000111

In accordance with and subject to the provisions of the Public Health Laws of Alabama and Chapter 420-3-1, Onsite Sewage Treatment and Disposal, adopted there under, and subject further to the terms and conditions set forth in this permit, the permittee is hereby authorized to distribute the product in the State.

ISSUANCE DATE: July 25, 2006

EFFECTIVE DATE: July 25, 2006

EXPIRATION DATE: July 24, 2011

MODIFICATION DATE: April 2, 2009

Alabama Department of Public Health

PART I – MONITORING REQUIREMENTS

A. DISCHARGE LIMITATIONS AND MONITORING REQUIREMENTS (All systems)

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the permittee products are authorized to discharge to:

The Effluent Disposal Field

Such product quality shall be limited and monitored by the permittee as specified below:

CHARACTERISTIC	UNITS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
		Minimum	Maximum	Measurement	Sample
Report Failures		Once every 6 months			

- The permittee shall provide to the Board a list of all distributors, and/or installers who are trained and authorized to install, maintain, and/or operate the permitted system(s) in Alabama. The list is to include the names, mailing addresses and telephone numbers. The list shall be updated and submitted either electronically or by regular mail to the Board annually.
- The permittee shall maintain a list of all System(s) installed in the State of Alabama, indicating the actual street location where each System(s) was installed. Said list shall be updated and submitted to the Board if requested.
- The permittee shall maintain a list of reported failures in the state and submit the list in accordance with **PART II** every six months for the period from January thru June and July thru December.
- The permittee shall adhere to any specific system requirements listed in **Part III** of this permit.

PART II – GENERAL PERMIT CONDITIONS

A. REPORTING REQUIREMENTS

1. Reporting Periods

   a. Reporting is to be started in the first full calendar month after the effective date of the permit.

   b. Any required reports shall be summarized on a form approved by the Department, and shall be reported to the Department no later than the 28th day of the month following the reporting period.

   c. Reports must be legible and bear an original signature. Photo or electronic copies of the signature are not acceptable and shall not satisfy the reporting requirements of this permit.

   d. Reports and forms required to be submitted by this permit, shall be signed by a "responsible person," or an "agent" of such person, and shall bear the following certification:

      "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a System(s) designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the System(s), or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for known violations."

   e. Reports and forms required to be submitted to the Department by this permit shall be addressed to:

      Division of Community Environmental Protection
Bureau of Environmental Services
Alabama Dept of Public Health
POB 303017
Montgomery, Alabama 36130-3017

B. OTHER REPORTING AND NOTIFICATION REQUIREMENTS

1. Termination of Product Production

   e. The permittee shall notify the Department, in writing, when the manufacture of the Product has permanently ceased. This notification shall serve as sufficient cause for instituting procedures for modification or termination of the permit.

2. Updating Information

   f. The permittee shall inform the Department of a change in the permittee's mailing address or telephone number or the permittee's designation of a facility contact or position having the authority and responsibility to prevent and abate violations of the Department's Rules and the terms and conditions of this permit, in writing, no later than ten (10) days after such change. Upon request of the Department , the permittee shall furnish the Department with an update of information provided in the permit application.

   g. If the permittee becomes aware that it failed to submit relevant facts in a permit application, or submitted incorrect information in a permit application or in a report to the Department, it shall promptly submit such facts or information with a written explanation for the mistake and/or omission.

3. Duty to Provide Information

   a. The permittee shall furnish to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, suspending, or revoking this permit in whole or in part, or to determine compliance with the permit.

C. OPERATIONAL AND MANAGEMENT REQUIREMENTS

1. Right of Entry and Inspection

   h. The permittee shall allow the Department or an authorized representative, upon presentation of credentials and other documents as may be required by law, to:

      1. Enter upon the premises where Product is manufactured or stored, and where records must be maintained as a condition of the permit;
      2. Have access to and copy, at reasonable times, any records required to be maintained by this permit;
      3. Inspect, at reasonable times, any Product, equipment, or practice relating to the Product and this permit.

D. DUTY TO COMPLY WITH PERMIT, RULES, AND STATUTES

1. Duty to Comply

   a. The permittee must comply with all conditions of this permit. Any noncompliance constitutes a violation of the permit and regulations and shall be grounds for enforcement action which may include termination, revocation and reissuance, suspension, modification, or denial of a permit.

2. Compliance with Statutes and Rules

   i. This permit is issued under authority of the Administrative Code of Alabama, Chapter 420-3-1. All provisions of this chapter are hereby made a part of this permit.

   j. This permit does not authorize noncompliance with or violation of any laws of the State of Alabama or the United States of America or any regulations or rules implementing such laws.

E. PERMIT REISSUANCE, TRANSFER, MODIFICATION, REVOCATION, AND SUSPENSION

1. Duty to Reapply

   k. The permittee shall file a complete permit application for re-issuance of this permit at least 90 days prior to its expiration.

   l. Failure of the permittee to apply for re-issuance at least 90 days prior to permit expiration will void the automatic continuation of the expiring permit provided by the Administrative Code of Alabama, Chapter 420-3-1, and should the permit not be reissued for any reason, any sales or provision of Product within this State after expiration of this permit shall be prohibited.

2. Changes in Product

   a. Prior to any modification, or significant change in the product, the permittee shall provide the Department with information concerning said modification or change. The permittee shall apply for a permit modification prior to the sale of any modified products in the State.

3. Transfer of Permit

   m. This permit may not be transferred or the name of the permittee changed without notice to the Department and subsequent modification or revocation and re-issuance of the permit, to identify the new permittee and to incorporate any other changes as may be required. In the case of a change in name, ownership or control, a request for permit modification in a format acceptable to the Department shall be submitted. Whenever the Department is notified of a change in name, ownership, or control, it may require the submission of a new permit application.

4. Permit Modification and Revocation

   n. This permit may be modified or reissued, in whole or in part, for cause, including, but not limited to, the following:

      1. If a request to transfer this permit has been received, the Department may decide to modify or reissue the permit,
      2. If modification or reissuance is requested by the permittee and is justified, the Department may

grant the request,

3. Material or substantial alterations, or additions to the Product or its production,
4. The Department has received new information not available at the time of permit issuance that would have justified different permit conditions,
5. Errors were made in calculating the limitations or in the text of the permit; or
6. When requested by the permittee and the Department determines that the modification is justified and will not result in a violation of federal or state law, rules, or regulations.

o. This permit may be revoked or terminated during its term for cause, including, but not limited to, the following.

1 Violation of any condition of this permit;
2. The permittee misrepresented or failed to disclose fully all relevant facts in the permit application or at any time during the permitting process.
3. Materially false or inaccurate statements, or information, were found in the permit application or the permit document;
4. The permittee's Product endangers or is menacing public health, or threatens the environment.
5. Permanent closure of the facility producing the Product or permanent cessation of Product production.

p. The filing of a request by the permittee for modification or reissuance, in whole or in part, does not automatically continue this permit or its conditions beyond the expiration date.

q. This permit may be suspended during its term for cause, including, but not limited to, the reasons for termination listed in Part II E.

F. PROPERTY AND OTHER RIGHTS

1. This permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to persons or property or invasion of other private rights, or any infringement of federal, state, or local laws or regulations, nor does it authorize or approve the construction of any physical structures or facilities or the undertaking of any work in any waters of the State or of the United States.

G. AVAILABILITY OF REPORTS

1. All reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. Product quality data shall not be considered confidential.

H. SEVERABILITY

1. The provisions of this permit are severable. If any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the other provisions of this permit shall remain in effect.

PART III – ADDITIONAL REQUIREMENTS SPECIFIC TO PRODUCT

A. CONDITIONS OF APPROVAL

1. The following conditions shall apply to this State permit and to all System(s) installed in Alabama:

a. This system may be used in place of rock aggregate in an absorption trench that is part of an onsite sewage disposal system permitted under Chapter 420-3-1 Onsite Sewage Disposal Rules.

b. The system may be installed on sites that meet all criteria of the Onsite Sewage Disposal Rules Chapter 420-3-1. These systems shall be sized in accordance with the sizing criteria below.

i. The primary EDF shall be a minimum of 300 square feet of the Gravel Field Standard or equivalent disposal medium/device unless designed by an engineer.

c. The permittee shall make adequate provisions for the prompt **service, repair, or maintenance** of System(s) installed in Alabama, and provide contact telephone numbers for the homeowner to report any malfunctions or problems.

d. System(s) shall be provided with a minimum **two-year warranty** that complies with the provisions of the Code of Alabama, 1975, §7-2-316(2), 7-2-714(1)(3), and 7-2-318, and under which the repair or replacement of a failing or defective product, System(s), or a component thereof shall be guaranteed at no cost to the owner.

e. The permittee shall insure that authorized distributors of their System(s) provide to the owner upon installation of the System(s) the following:

i. Name, address and telephone number of the distributor selling the System(s) and providing the warranty

ii. The two-year written warranty.

f. The permittee shall supply to the Board, its distributors, and engineers **an initial instruction manual** to guide the design and construction of the System(s). The permittee shall supply an updated manual when major changes to the design of the system(s) are incorporated. The manual shall include the following information, as applicable:

i. A description of the System(s) and how it works;
ii. Instructions for sizing the absorption field;
iii. A design and calculation worksheet;
iv. Detailed, step-by-step, instructions for System(s) installation;
v. Detailed instructions for operation, inspection, and maintenance;
vi. Instructions for setting, adjusting, and troubleshooting;
vii. Typical plan view, sectional, profile, and detail drawings;
viii. A copy of the warranty;
ix Name and telephone of contact person/representative; and
x. A complete list of all parts necessary for an installation.

g. No System(s) shall be installed, serviced, or maintained in Alabama except by a contractor who has been licensed by the Alabama Onsite Wastewater Board, <u>and</u> who has been trained, and authorized by the permittee to do such work

h. The permittee shall provide to the Board a list of all distributors, and/or installers who are trained and authorized to install, maintain, and/or operate the permitted system(s) in Alabama. The list is to include the names, mailing addresses and telephone numbers. The list shall be updated and submitted either electronically or by regular mail to the Board annually.

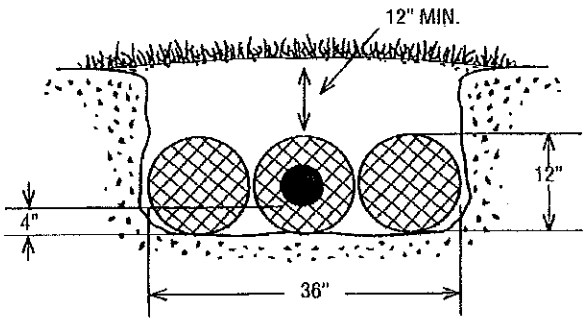
i. Upon discovery of **a failing system**, the permittee and its authorized representative shall inform the county health department. A report shall be prepared and presented by the permittee to the county health department and to the Board, giving the location of the failed System(s), the owner's name, the date and size of the installation, and the installers' name. The report shall explain the suspected cause(s) of the failure, if known, and the appropriate remedies for a repair.

j. The criteria for determining **a failing system,** or component thereof, shall be as follows:

i. A breakage, weakness, or defect in the product that causes a malfunction in the treatment, distribution, disposal, or dispersal of effluent into the soil absorption field, or which causes a wash-out or disruption of the effluent disposal field.
ii. Surfacing or ponding of effluent at, over, or around the System(s) or effluent disposal field.
iii. Backing up of sewage within the residence caused by ponding within the product, as noted above.

Flowtech Sizing
Diagrams and Sizing Calculations
Alabama Dept of Public Health

FTS 123H-1



PROPERTIES AND SPECIFICATIONS

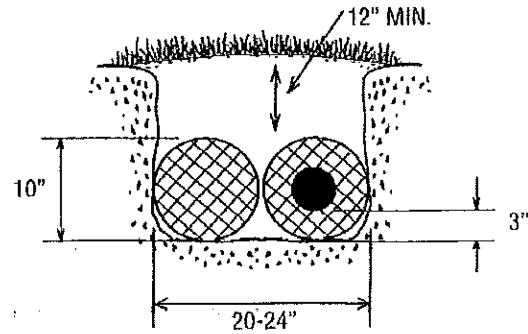
Overall System Height	12"
Invert Height	4"
Trench Width	36"
Trench Depth	24"
Trench Modification	25%

Configuration factor for FTS 123H-1 = 0.25

Sizing Example: 300 sq. ft. required

300 x 0.25 = 75 ft. required

FTS 102H-1



PROPERTIES AND SPECIFICATIONS

Overall System Height	10"
Invert Height	3"
Trench Width	20-24"
Trench Depth	22"
Trench Modification	10%

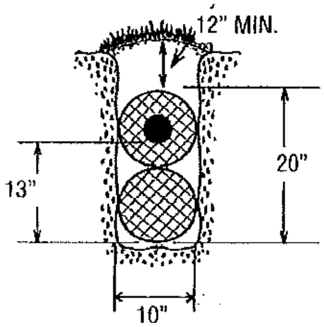
Configuration factor for FTS102H-1 = 0.30

Sizing Example: 300 sq. ft. required

300 x 0.30 = 90 ft. required

Flowtech Sizing
Diagrams and Sizing Calculations
Alabama Dept of Public Health

FTS 102V-1

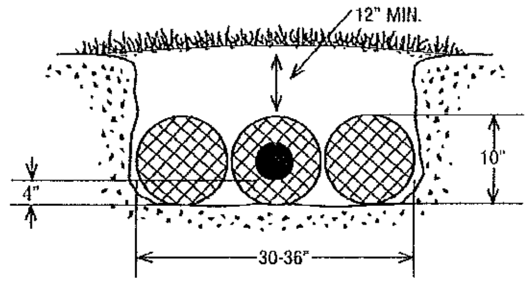


PROPERTIES AND SPECIFICATIONS

Overall System Height	20"
Invert Height	13"
Trench Width	10"
Trench Depth	26"
Trench Modification	25%

Configuration factor for FTS 102V-1 = 0.25
Sizing Example: 300 sq. ft. required
300 x 0.25 = 75 ft. required

FTS 103H-1



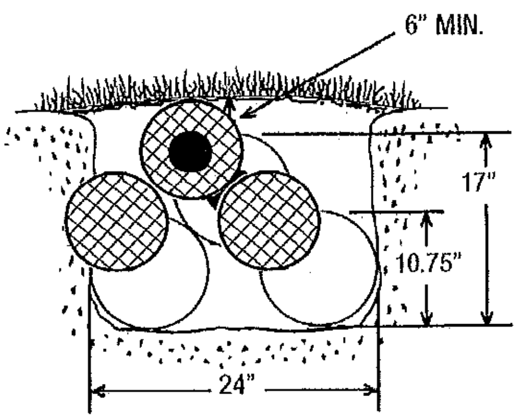
PROPERTIES AND SPECIFICATIONS

Overall System Height	10"
Invert Height	4"
Trench Width	30-36"
Trench Depth	24"
Trench Modification	25%

Configuration factor for FTS 103H-1 = 0.25
Sizing Example: 300 sq. ft. required
300 x 0.25 = 75 ft. required

Flowtech Sizing
Diagrams and Sizing Calculations
Alabama Dept of Public Health

FTS 103T-1

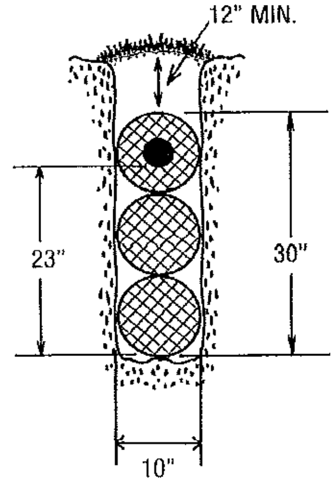


PROPERTIES AND SPECIFICATIONS

Overall System Height	17"
Invert Height	10.75"
Trench Width	24"
Trench Depth	25-29"
Trench Modification	40%

Configuration factor for FTS 103T-1 = 0.20
Sizing Example: 300 sq. ft. required
300 x 0.20 = 60 ft. required

FTS 103V-1



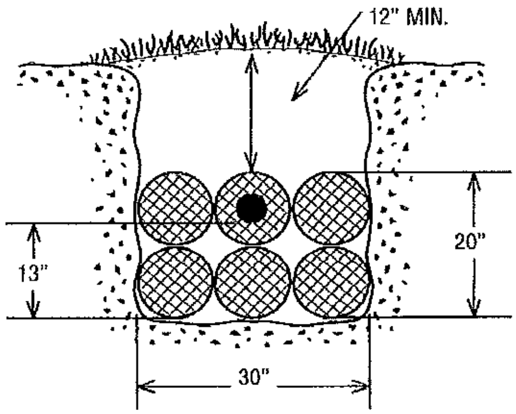
PROPERTIES AND SPECIFICATIONS

Overall System Height	30"
Invert Height	23"
Trench Width	10"
Trench Depth	36"
Trench Modificaion	52%

Configuration factor for FTS 103V-1 = 0.16
Sizing Example: 300 sq. ft. required
300 x 0.16 = 48 ft. required

Flowtech Sizing
Diagrams and Sizing Calculations
Alabama Dept of Public Health

FTS 106H-1

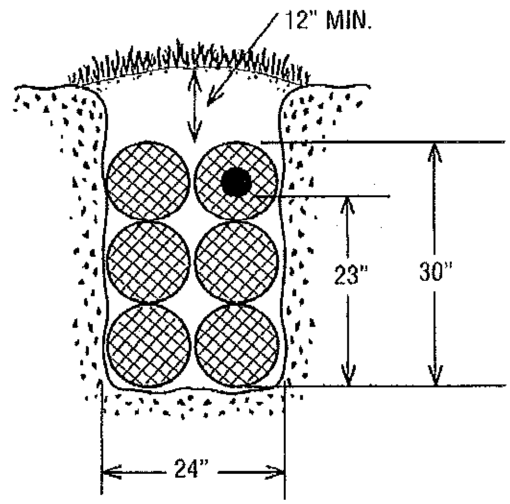


PROPERTIES AND SPECIFICATIONS

Overall System Height	18"
Invert Height	13"
Trench Width	30-36"
Trench Depth	30"
Trench Modification	49%

Configuration factor for FTS 106H-1 = 0.17
Sizing Example: 300 sq. ft. required
300 x 0.17 = 51 ft. required

FTS 106V-1



PROPERTIES AND SPECIFICATIONS

Overall System Height	30"
Invert Height	23"
Trench Width	24"
Trench Depth	42"
Trench Modification	70%

Configuration factor for FTS 106V-1 = 0.10
Sizing Example: 300 sq. ft. required
300 x 0.10 = 30 ft. required

Georgia Department of Human Resources
Division of Public Health
Environmental Health Section

Alternative System Approval

For: ICC Flowtech FTS123H-1 Drainage System

Issued To: ICC Technologies, Inc.
240 Boundary Road
Marlboro, New Jersey 07746

In accordance with provisions established in the Department of Human Resources Rules and Regulations for On-Site Sewage Management Systems, Chapter 290-5-26, the ICC Flowtech FTS123H-1 Drainage System is provisionally approved, until May 1, 2009, for use in on-site sewage management systems under the following conditions:

I. System Description

The ICC Flowtech FTS123H-1 Drainage System utilizes wastewater absorption trenches that contain bundles of loosely bound expanded polystyrene (EPS) aggregate in place of rock aggregate. The aggregate shall consist of EPS with a particle density of 1.42 pounds per cubic foot, or greater, ranging in size from one-half (1/2") inch to two (2") inches across any axis.

Cylindrical bundles are a nominal twelve (12") inches in diameter. The length of the cylindrical bundles range from a minimum of 5 feet to a maximum of 15 feet. The expanded polystyrene aggregate (EPS) is held in a cylindrical shape with high strength polyethylene netting. The netting shall be strong enough to retain the shape of the bundles during system installation and backfilling, corrosion resistant, and of a mesh size to prevent loss of aggregate. At least one cylinder bundle shall contain a perforated flexible plastic pipe for connection to adjacent sections to form a continuous absorption field system. The perforated flexible plastic pipe shall meet ASTM F 405, Standard Specifications for Corrugated Polyethylene Pipe. A series of three holes 5/8" in diameter spaced 120 degrees around the circumference are located every 4 inches along the lateral length of the pipe. Based on the manufacturer's recommendation, the hole orientation during installation may be random.

System Configuration

ICC Flowtech FTS123H-1 Drainage System consists of three, 12-inch diameter cylinder bundles across the bottom of a 36-inch wide absorption trench. The central cylinder bundle contains EPS aggregate and a four-inch diameter perforated flexible plastic pipe. The pipe shall be centered within the EPS aggregate and connected by an internal coupling device, or other approved coupling device, to allow continuous flow from one section to the adjacent section. The pipe may be offset, noted as OC at the end of the product code, so there is approximately 6 inches of EPS aggregate from the bottom of the pipe to the bottom of the cylinder, and 2 inches of EPS aggregate from the top of the pipe to the top of the cylinder. The cylinder bundles on each side of the central cylinder bundle contain EPS aggregate only (aggregate bundles may be substituted with pipe and aggregate bundles).

II. Site Criteria

The ICC Flowtech Drainage System may be utilized on sites determined to be suitable for conventional absorption field systems as specified in the DHR Rules and Regulations for On-Site Sewage Management Systems and the Department's Manual for On-Site Sewage Management Systems. The vertical separation requirements from seasonal groundwater, rock, impervious soil layers, or other unsuitable environmental conditions shall be measured from the absorption trench bottom.

III. Installation Criteria

The ICC Flowtech Drainage System shall be installed in the configurations in Section I, in absorption trenches constructed in accordance with the DHR Rules and Regulations for On-Site Sewage Management Systems, the Department's Manual for On-Site Sewage Management Systems and this approval document.

The excavated trench width shall be 36 inches as indicated in Section I.

The ICC Flowtech FTS123H-1 Drainage System shall only be utilized for domestic waste as defined in Chapter 290-5-26-.02(rr) Rules and Regulations for On-Site Sewage Management Systems.

The barrier cover for any ICC Flowtech configuration shall be as designated by the manufacturer.

IV. Absorption Field Sizing

The sizing of the ICC Flowtech Drainage System shall be based upon the anticipated peak daily volume of treated sewage and the characteristics of the soil in which the absorption fields are to be located. The design absorption rate shall be based on the most hydraulically limiting naturally occurring soil horizon encounter at the aggregate and soil interface along the sidewall and trench bottom area to a depth 1 foot below the absorption trench bottom.

For lots less than three acres in size, soil horizons that exceed a percolation rate of 90 minutes per inch shall not be considered for installation.

On tracts or parcels of land of three acres or more, soil horizons that exceed a percolation rate of 120 minutes per inch shall not be considered for installation.

The following equivalency factors shall be used for the ICC Flowtech FTS123H-1 Drainage System:

System Configuration	Equivalency Factor
ICC Flowtech 123H-1	0.75

Trench Installation:

Step One: Determine the design percolation rate. The design percolation rate shall be based on the most hydraulically limiting soil horizon along the sidewall and trench bottom area interfacing with the product infiltrative surface to a depth 1 foot below the trench bottom.

Step Two: Determine the linear length required for a conventional 36-inch wide gravel absorption field system based on the percolation rate identified in step one.

Step Three: Identify the ICC Flowtech configuration to be installed. Multiply the product equivalency factor for the ICC Flowtech configuration to be used by the linear length of the conventional system determined in step two. The result is the linear footage required for the ICC Flowtech configuration selected.

Example:

Assume: 3-bedroom house and a percolation rate of 45 minutes per inch.

Then: Absorption field square footage required for a conventional 36-inch wide absorption field from Table DT-2 for a 45 minute percolation rate is 300 square feet per bedroom or 900 square feet for the three-bedroom house. The linear length required for the conventional 36-inch wide absorption field is 300 linear feet.

The minimum required linear footage (for this example) of the ICC Flowtech FTS123H-1 Drainage System is:

ICC Flowtech 123H-1: 300 ft. x 0.75 = 225 ft.

By: [signature] Date: 4/01/08

Scott A. Uhlich,
Director
Environmental Health Branch

An Affiliate of
the Maryland Association
of Counties, Inc.

MARYLAND CONFERENCE OF LOCAL ENVIRONMENTAL HEALTH DIRECTORS

Reply to:

January 22, 2008

Mr. Harry Bussey, III
ICC Technologies, Inc
240 Boundary Road
Marlboro, NJ 07746

Dear Mr. Bussey:

I am writing in reply to the ICC Flowtech October 16, 2007 request for review and approval of 10" and 12" Flowtech Synthetic Aggregate Drain Pipes for installation in the state of Maryland. The ICC Flowtech 10" and 12" Flowtech Synthetic Aggregate Drain Pipes were reviewed by the Maryland Conference of Local Environmental Health Directors and Maryland Department of the Environment Groundwater Permits Program Product Review Committee.

The committee reviewed the information submitted and found no objections to the use of the ICC Flowtech Synthetic Aggregate Drain Pipes as an alternative to a gravel aggregate system when properly installed. The ICC Flowtech Synthetic Aggregate Drain Pipe can be used in Maryland with the following conditions:

- There is no allowance for reduction in the amount of absorption area, the drainfield requirement remains the same as with a gravel aggregate system
- The property owner acknowledges, in writing to the Health Department, that this is an alternative to a gravel aggregate system and allows the Health Department to periodically inspect the system.
- Inspection ports are to be installed.

The members of the Maryland Conference of Local Environmental Health Directors have been supplied with the results of the Committee review.

Please be advised that the authority for final product approval and use is delegated to the individual counties and they may have more stringent requirements than state regulations. Favorable review by the Committee does not eliminate the need for individual county approval.

If you have any further questions regarding this matter, please call me at 410-222-7095.

Sincerely,

Kerry Topovski
President

cc: Craig Williams, MDE
Barry Glotfelty, MDE

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
P.O. Box 029
Trenton, New Jersey 08625-0029
Tel: 609-633-7021 / 609-292-0407
Fax: 609-984-2147
www.state.nj.us/dep/dwq/nonpoint.htm

JON S. CORZINE
Governor

MARK N. MAURIELLO
Acting Commissioner

March 20, 2009

Harry Bussey
ICC Tehnologies, Inc.
240 Boundary Road
Marlboro, NJ 07746

Re: Treatment Works Approval # 00-3487-4SG

Dear Mr. Bussey:

The Department of Environmental Protection has re-issued a Treatment Works Approval (TWA) for the use of products in lieu of the gravel filter material, gravity distribution pipe, and drainage fabric in a standard individual subsurface sewage disposal system designed pursuant to N.J.A.C. 7:9A-1 et seq. The names of the products approved under this TWA will be supplied in Appendix 1 to the permit and updated as needed to reflect new or changing technology. The enclosed TWA describes the approved siting, design, construction, operation and maintenance requirements for the use of these products. The main focus of this TWA is to allow the use of gravel alternatives, not to alter the sizing of disposal fields. Design and construction approvals for individual subsurface sewage disposal systems which incorporate a product in lieu of the gravel filter material, gravity distribution pipe, and drainage fabric can be issued directly by the administrative authority for new construction systems that meet the requirements of the TWA.

Products which have H10 Load Testing Reports on file with this Bureau are currently included in Appendix 1.. Additional products will be added to Appendix 1 if an H10 Load Testing Report is submitted to this Bureau.

If you have any questions regarding the content of this approval, contact the Onsite Wastewater Management Unit at the address or phone numbers listed above.

Sincerely,

Barry Chalofsky, P.P., Chief
Bureau of Nonpoint Pollution Control

enclosure

CC: Chron

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
P.O. Box 029, TRENTON, NJ 08625-0029

PERMIT TO CONSTRUCT AND OPERATE* TREATMENT WORKS

**Local Agency approval required prior to operation*

The New Jersey Department of Environmental Protection grants this permit in accordance with your application, attachments accompanying same application, and applicable laws and regulations.

PERMIT NO.	ISSUANCE DATE	EXPIRATION DATE	DESIGN FLOW
00-3487-4SG	March 20, 2009	See below	N/A

NAME AND ADDRESS OF APPLICANT
New Jersey Department of Environmental Protection
Bureau of Nonpoint Pollution Control
P.O. Box 029
Trenton, New Jersey 08625-0029

LOCATION OF ACTIVITY
Counties: All
Municipalities: All

A. General Requirements:

This approval authorizes the administrative authority to approve an individual subsurface sewage disposal system which uses a product in lieu of the gravel filter material, gravity distribution pipe, and drainage fabric in a standard individual subsurface sewage disposal system design pursuant to N.J.A.C. 7:9A-1 et seq. Distribution pipe is required in pressure dosing applications. Serial distribution is prohibited as per N.J.A.C.7:9A-9.1(b). The use of an effluent filter in the septic tank is required for all systems using these gravel alternative disposal products. All other aspects of the individual subsurface sewage disposal design and construction not specifically covered by this approval must conform to N.J.A.C. 7:9A-1 et seq.

B. Administration:

This approval is valid when incorporated into a final construction approval from the administrative authority. Construction and Operation of such an approved system may not commence until final construction approval from the administrative authority is received. The administrative authority shall submit a list of all approved systems authorized under this TWA annually (by June 1) to the Department using the spreadsheet for gravel alternative systems available through the Department.

C. Product Specifications:

Specific products approved by this TWA will be identified in a supplemental table, Appendix 1. Products listed in Appendix 1 have submitted to the Department structural testing reports and results for H10 Load Testing. Appendix 1 will be updated as needed and be made available to the local administrative authority at anytime through email notification and posting on the Department's website. These gravel alternative products may be used for a trench or bed configuration according to these guidelines in conventional, soil replacement-bottom lined, soil replacement-fill enclosed, mounded, mounded soil replacement systems, as described in N.J.A.C. 7:9A-10.2(a).

APPROVED by the Department of Environmental Protection

Barry Chalofsky, P.P., Chief
Bureau of Nonpoint Pollution Control

Date

This permit is also subject to special provisos and general conditions stipulated on the attached page(s) which are agreed to by the permittee upon acceptance of the permit.

D. Site Requirements:

The location of the individual subsurface sewage disposal system must conform to all provisions of N.J.A.C. 7:9A-1 et seq.

No construction of the individual subsurface sewage disposal system or the proposed realty improvement shall begin until the administrative authority has provided written notification to the applicant that all aspects of the design and construction of the individual subsurface sewage disposal system which are not authorized under this treatment works approval are in strict conformance with N.J.A.C. 7:9A-1 et seq.

The issuance of this permit does not exempt the applicant of the responsibility to comply with all other applicable Federal, State, County and Municipal rules and regulations.

E. System Design Requirements:

1. An individual subsurface sewage disposal system that incorporates products in lieu of the gravel filter material, gravity distribution pipe, and drainage fabric shall also incorporate an effluent filter in its design.

2. Disposal fields incorporating products used in lieu of the gravel filter material, gravity distribution pipe, and drainage fabric shall be sized based upon the following:

a) **Disposal Beds:**

$A = Q \times R$

A = Minimum disposal area required ($ft.^2$)
Q = Design volume of sanitary sewage (gal. per day)
R = Recharge rate based upon permeability ($ft.^2$/gal. per day)

Determine minimum disposal area required based upon the results of permeability tests or percolation tests performed as prescribed in N.J.A.C. 7:9A-6.

The product used in lieu of the gravel filter material, gravity distribution pipe, and drainage fabric shall be placed within the boundary of the disposal area, as calculated above, according to the manufacturer's recommendations. If the manufacturer recommends a specified spacing between product units, the disposal area does not need to be increased as long as the soil between the units will become saturated also. If the soil between the units will not become saturated, the minimum disposal area must equal the bottom area of the units only, not the space between the units.

Table 1. Minimum required Disposal Field Bottom Area per Gallon of Daily Sewage Volume (A/Q) (N.J.A.C. 7:9A-Table 10.2(c))

Permeability Rate (in./hr.)	Percolation Rate (min./in.)	Recharge Rate (A/Q ($ft.^2$/gal. per day))
6-20	3-15	1.61
2-6	16-30	2.08
0.6-2	31-45	2.56
0.2-0.6	46-60	2.94
Pressure Dosing w/ Select Fill*	Pressure Dosing w/ Select Fill*	1.33**

* *Select Fill is fill material meeting the specifications in N.J.A.C. 7:9A-10.1(f)4.*

** *All disposal beds using pressure dosing, except for conventional installations, and all bottom-lined soil replacement trench installations using pressure dosing shall have a minimum size of 1.33 square feet of bottom area per gallon of sewage volume. All other disposal field installations shall be based upon the permeability at the level of infiltration.*

F. System Design Requirements (cont'd):

b) **Disposal Trenches:**

L = A/(W+H)

L = linear feet of trench required (feet)
A = minimum disposal area required, calculated as determined in Table 1., ($ft.^2$)
Q = Design volume of sanitary sewage (gal. per day)
R = Recharge rate based upon permeability ($ft.^2$/gal. per day)
W = width of trench = width of unit (feet)
H = trench sidewall height available for disposal (H = 1 foot)

For example, if the permeability rate is 2-6 in./hr, the minimum disposal area required will be 2.08 $ft.^2$/gal. per day. This value would be used for A in the equation above. Thus, for the example, L = A/(W+H) would be calculated as L= 2.08 $ft.^2$/gal. per day/(2.0 ft + 1.0 ft) = 0.69 feet/gal-day. *The actual calculation should be performed using actual numbers based on the site conditions.*

All other aspects of the design of the individual subsurface sewage disposal system must conform to the provisions of N.J.A.C. 7:9A-1 et seq.

G. System Construction Requirements:

The construction of the individual subsurface sewage disposal system must conform to all provisions of N.J.A.C. 7:9A-1 et seq. This approval only authorizes the use of products in lieu of the gravel filter material in the construction of the disposal field for an individual subsurface sewage disposal system.

H. System Operation and Maintenance Requirements:

The operation and maintenance of the individual subsurface sewage disposal system must conform to all provisions of N.J.A.C. 7:9A-1 et seq.

Appendix 1

The Department of Environmental Protection has issued a Treatment Works Approval (TWA) for the use of products in lieu of the gravel filter material, gravity distribution pipe and drainage fabric in a standard individual subsurface sewage disposal system designed pursuant to N.J.A.C. 7:9A et seq. The following are products covered by this TWA, permit number 00-3487-4SG:

COMPANY	PRODUCTS	TYPE
ADS/ Hancor	BioDiffuser ARC	Chamber
Eljen	In-Drain System	Non-aggregate drainfield
Infiltrator	Standard Sidewinder High Capacity Sidewinder Equalizer 24 Equalizer 36 Quick4 Standard High Capacity H-10 Quick4 Hi-capacity (Q4HICAP) Quick4 Equalizer 36 (Q4EQ36) Quick4 Equalizer 24 (Q4EQ24) Quick4 Standard-Wide (Q4STDW)	Chamber
ICC Flowtech	FTS123H FTS142H	Absorption trench with polystyrene aggregate

This table will be updated regularly to include newly approved technologies for use in lieu of gravity filter material, distribution pipe and drainage fabric.

All aspects of design, installation and construction of these systems must conform to TWA # 00-3487-4SG and those not specifically covered must conform to N.J.A.C. 7:9A et seq.

STATE OF NEW YORK
DEPARTMENT OF HEALTH
Flanigan Square 547 River Street Troy, New York 12180-2216

Richard F. Daines, M.D.
Commissioner

Wendy E. Saunders
Chief of Staff

July 29, 2008

Mr. Harry Bussey
ICC Technologies, LLC
240 Boundary Road
Marlboro, NJ 07746

Re: "ICC Flowtech" Polystyrene Aggregate Products
for Onsite Wastewater Treatment Systems

Dear Mr. Bussey:

This letter is in reply to your written request to allow the use of the "ICC Flowtech" bundled polystyrene aggregate absorption trench products in New York State. This Department does not "approve" proprietary products. We will, however, review products to determine their compliance with New York State regulations.

The applicable regulation used in our review is 10NYCRR Appendix 75-A, "Wastewater Treatment Standards - Individual Household Systems". The ICC Flowtech products have similar characteristics to a "conventional" stone aggregate trench in terms of infiltrative surface area and storage volume. Based upon the product information and specifications provided, the ICC Flowtech **FTS12224H, FTS123H-1 and FTS14230** products may be used as an equivalent to a conventional (24-inch wide) absorption trench on a 1:1 linear foot basis. Please note, Appendix 75-A.8 (2)(ii) that adjacent trenches shall be separated by at least four feet of undisturbed soil. **FTS123H-1** and **FTS14230** products may require additional area. since installation of these products will require a wider trench.

You also requested approval for consideration of a 25% reduction in trench length for several products, in accordance with the Department of Health's November 24, 2004 Interoffice Memorandum titled, "Onsite Wastewater Treatment Systems: Specific Waiver Criteria - Gravelless Systems and Secondary Treatment Units (STUs)". The reduction allowance is based upon a significant increase in infiltrative surface area and storage volume provided by some manufactured absorption trench products over conventional stone aggregate trench systems. The **FTS12224, FTS123H-1 and FTS14230** products do provide some increased infiltration surface area and storage but not enough to merit consideration for a 25% reduction in trench length. However, upon review of product information provided, the **FTS123T-1 and FTS103T-1** product configurations, when installed in a 24-inch wide trench, provide increased sidewall infiltration area and storage volume sufficient to be allowed the 25% reduction in accordance with the Interoffice Memorandum. At this time, the application of a trench length reduction will require the issuance of a Specific Waiver from the local health department having jurisdiction.

P:\Sections\Residential Sanitation\OWTS\PRODUCTS\ICC Flowtech\ICCFlowtechApprolletter2.doc

The use of proprietary products for onsite wastewater treatment products is also subject to the conditions and requirements of local health departments and/or local code enforcement officer. Local standards may be more stringent than those included in Appendix 75-A.

This is in no way intended to be, nor should it be construed as, an endorsement for your product. If you have any questions, please contact me at (518) 402-7650.

Sincerely,

Mark G. Wykes, P.E.
Senior Sanitary Engineer
Bureau of Water Supply Protection
Residential Sanitation Section

cc: Mr. Ben Pierson - NYSDOH - BWSP

P:\Sections\Residential Sanitation\OWTS\PRODUCTS\ICC Flowtech\ICCFlowtechApprolletter2.doc

OHIO DEPARTMENT OF HEALTH
246 North High Street
Columbus, Ohio 43215
614/466-3543
www.odh.ohio.gov
Ted Strickland/Governor
Alvin D. Jackson, M.D./Director of Health

DIRECTOR'S JOURNAL ENTRY

APPROVAL OF ALTERNATIVE LEACHING TRENCHES AS A SPECIAL DEVICE FOR SEWAGE TREATMENT SYSTEMS

Recently adopted revisions to Chapter 3701-29 of the Administrative Code set forth specifications for sewage disposal systems and include traditional systems such as septic tanks to leach lines for soil absorption. The rules do not specify other methods of soil absorption, such as alternative leaching trenches. This type of system design, however, has been used in many counties in Ohio prior to January 1, 2007 under the experimental concurrence process, and during the period of January 1 through June 30, 2007, by direct authorization in the rules (now rescinded). Due to the challenging nature of soils and the presence of seasonal water table conditions across the state, alternative leaching trenches are still needed for use in ensuring treatment of sewage on lot while preventing public health nuisances.

Under the authority of rule 3701-29-20(C) of the Administrative Code, the Director of Health may approve special devices or systems that differ in design or principle of operation from those set forth in the rules. The standards and criteria for alternative leaching trenches attached to this entry have been reviewed and recommended for approval by the Sewage Treatment Systems Technical Advisory Committee for use as a sewage treatment system in Ohio at their meeting on July 10, 2007. Therefore, alternative leaching trenches as described in the attachment, and designed, installed and maintained in accordance with the conditions as specified are now approved as a sewage treatment system special device for use in Ohio.

8/28/07
Date

Alvin D. Jackson, MD
Director of Health

Healthy Ohio

D H E C

PROMOTE PROTECT PROSPER

C. Earl Hunter, Commissioner

Promoting and protecting the health of the public and the environment

April 14, 2009

Harry Bussey, III
ICC Technologies, Inc.
240 Boundary Road
Marlboro, NJ 07746

Re: Approval for ICC Technologies, Inc. Product Modifications

Dear Mr. Bussey:

Thank you for your request for approval for the modifications of the ICC Technologies systems in South Carolina to include the geotextile fabric covering on the top of the bundles.

After reviewing your request, the South Carolina Department of Health and Environmental Control, Division of Onsite Wastewater Management hereby approves the following systems for installation in South Carolina: FTSG103H-1, FTSG123H-1, and FTSG142-1. The configurations and sizing will be the same as the previously approved configurations.

Please allow us time to disseminate the information about these systems to our personnel.

If you have any questions concerning the authorization, please feel free to contact me at (803) 896-0641.

Sincerely,

William H. Burriss
Division of Onsite Wastewater Management
Bureau of Environmental Health

cc: Leonard Gordon
Roger Scott

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Ground Water Protection
10th Floor, L & C Tower
401 Church Street
Nashville, Tennessee 37243

March 24, 2008

Mr. Harry Bussey
ICC Technologies LLC
240 Boundary Road
Marlboro, NJ 07746

Re: State of Tennessee experimental approval for the use of ICC Flowtech FTS14OC and FTS123H-1OC

Dear Mr. Bussey:

This letter is to inform you that the State of Tennessee, Division of Ground Water Protection (GWP) has reviewed the information you submitted and agrees to allow the above-referenced products to participate in the experimental program. The following describes the manner in which GWP will allow the products to be used.

The ICC Flowtech FTS142H Drainage System consists of one, 14.5-inch diameter cylinder bundle. The cylinder bundle contains EPS aggregate and a 4-inch diameter perforated flexible plastic pipe that is off-set so that there is a means to provide 6 inches of aggregate below the pipe. The FTS142H bundles shall be installed in 18-inch wide absorption trenches and placed such that there is at least 6 inches of aggregate below the distribution pipe. The bundles within the same disposal trench shall be interconnected end to end with an internal pipe coupler to allow for continuous flow from one section to the next. After installation in the trench, the pipes must be completely covered with geotechnical fabric or a layer of straw at least 2 inches thick. The ICC Flowtech FTS142H will be allowed to be installed on a foot per foot basis with a three-foot wide conventional gravel trench as sized in Appendix II of the **Regulations To Govern Subsurface Sewage Disposal (SSD) Systems.** However due to the height of the product, the ICC Flowtech FTS142H will not be allowed in soils that are limited to 24 to 26 inch depth of installation restrictions.

The ICC Flowtech FTS123H-1OC consists of three, 12-inch diameter cylinder bundles. The central bundle contains EPS aggregate and a 4-inch diameter perforated flexible plastic that is off-set so that there is a means to provide 6 inches of aggregate below the pipe. The other two bundles contain EPS aggregate only. The FTS123H shall be installed in 36-inch wide absorption trenches. The central bundle shall be installed such that there is at least 6 inches of aggregate below the distribution pipe. The central bundles within the same disposal trench shall be interconnected end to end with an internal pipe coupler to allow for continuous flow from one section to the next. The central bundle shall be placed such that there is an aggregate-only bundle on each side. After installation in the trench, the pipes must be completely covered with geotechnical fabric or a layer of straw at least 2 inches thick. The ICC Flowtech FTS123H-1OC will be allowed to be installed at a 30% reduction from a conventional three-foot wide gravel trench as sized in Appendix II of the **Regulations To Govern Subsurface Sewage Disposal (SSD) Systems** for soil absorption rates of 10 through 60 minutes per inch (MPI), while permits in soil rates above 60 MPI shall be installed foot per foot as with conventional. **Any site where an ICC Flowtech Sytem is proposed must meet the same site suitability and construction requirements as for a conventional system. This includes the complete primary and duplicate disposal field footprint that would be required for a three-foot wide conventional gravel media disposal field.**

GWP will allow a maximum of 80 of the ICC Flowtech FTS142H, and 80 of the ICC Flowtech FTS123H-1OC systems to be installed, at which time the performance of one or both systems will be evaluated by GWP or a research facility or university designated by GWP. Systems may be installed in soils with an estimated absorption rate of 10-105 MPI. In lieu of the standard restrictive covenant associated with experimental systems, ICC Technologies LLC shall provide a written five-year warranty to the homeowner warranting the product from defects in materials and workmanship. An experimental application fee of $500.00 shall apply to any application for the above-mentioned products. A high intensity soil map may be required on any prospective site, which will be reviewed on a site-by-site basis by the Central Office of GWP. All permitting and fee collections will be handled through the Central Office of GWP. Mr. Randall Masters will serve as the primary contact for this project.

It is also important to note that GWP is currently working with University of Tennessee in order to reevaluate sizing criteria (volume, surface area, etc.) of all drain field products currently approved for use in Tennessee. Results of that study may affect this approval. GWP reserves the right to amend/resend any or all of this approval pursuant to new discovery. In the event any changes are made to this approval, you will be notified by mail.

If you have any questions regarding this matter, please feel free to contact Mr. Masters at (615) 532-0768.

Sincerely,

Alan Schwendimann
Director
Division of Ground Water Protection

VAS/bch

CC: Conner Franklin, Jackson Environmental Field Office
Tom Carlton, Nashville Environmental Field Office
Jim Teeple, Cookeville Environmental Field Office
Jeff Coggin, Columbia Environmental Field Office
Harold Deep, Chattanooga Environmental Field Office
Michael Caudill, Knoxville Environmental Field Office
John Parks, Johnson City Environmental Field Office
Gary Ferguson, Blount County Environmental Health
Spencer Hissam, Davidson County Environmental Health
Gary Pickett, Hamilton County Environmental Health
Tom Carter, Jefferson County Environmental Health
Mark Jones, Knox County Environmental Health
Steve Bell, Madison County Environmental Health
Mark Samples, Sevier County Environmental Health
Greg Parker, Shelby County Environmental Health
Brian Corwin, Williamson County Environmental Health

COMMONWEALTH of VIRGINIA

Karen Remley, MD, MBA, FAAP
State Health Commissioner

Department of Health
P O BOX 2448
RICHMOND, VA 23218

TTY 7-1-1 OR
1-800-828-1120

March 31, 2009

Mr. Harry Bussey, CEO
ICC Technologies, LLC
240 Boundary Road
Marlboro, New Jersey 07746

CERTIFIED MAIL

Dear Mr. Bussey,

I received your revised binder on March 11, 2009 that clarified the ICC Technologies, LLC product information for approval under GMP#116. The revised request is for 14 configurations of specific products that range from FTS 103 H-1 through FTS 143H-1. You have adequately addressed the questions I raised in my September 24, 2008 letter which dealt primarily with the Installation Guide.

The information substantially complies with the requirements of GMP#116. Authorization for installation of Substituted Systems as outlined in GMP#116 and the March 9, 2009 Installation Guide will be granted upon receipt of evidence of financial assurance to the Virginia Department of Health in the amount of at least $100,000. In your March 9, 2009 submission, you submitted a blank template of such letter of credit. From our telephone conversation of March 30, 2008, you indicated that you would begin work toward submission of the financial assurance letter.

This letter constitutes the Department's decision in this matter. You may appeal this decision by requesting an informal fact-finding conference. If you wish to appeal, your written request must be received in this office within 30 days of your receipt of this letter. Please call me at (804) 864-7460 if you have questions.

Sincerely,

Daniel Price, Program Manager
Division of Onsite Sewage and Water Services

c. Mr. Bobby Barnes, Unifour
Mr. Robert Hicks, Director, OEHS

Gravel Substitute Products						
Product / Model	**Unit Size W / L / H (inches)**	**Void Space per foot^3 of media (cu. ft)**	**Void Space per arrangement of units (cu. ft)**	**Void Space per linear foot of trench (cu. ft)**	**Infiltrative Surface per arrangement of units (sq. ft.)**	**Infiltrative Surface per linear foot (sq. ft.)**
ICC Flowtech Drainage Systems						
FTS103H	10" x 30" x 120" Horizontal arrangement of three 10" diameter "tubes" in a 30" wide trench.	0.4	7.2	0.72	25	2.5
FTS123H	12" x 36" x 120" Horizontal arrangement of three 12" diameter "tubes" in a 36" wide trench.	0.4	10.1	1.01	30	3.0

Please be advised that this registration expires on December 31 of each year. Manufacturers desiring to continue product registration must obtain department renewal according to the requirements in WAC 246-272A-0145(5). If the department finds the product has changed in any way that affects performance, it may not be renewed and must meet the requirements for initial registration.

If you have any questions, please contact me at (360) 236-3043 or by email at leslie.turner@doh.wa.gov.

Sincerely,

Leslie Turner

Leslie Turner
Wastewater Management Specialist

Cc: Environmental Health Directors
Sewage Program Coordinators

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
OFFICE OF SHELLFISH AND WATER PROTECTION
PO Box 47824 • Olympia, Washington 98504-7824
(360) 236-3330 • TDD Relay Service: 1-800-833-6388

February 20, 2009

Harry Bussey, CEO
ICC Technologies
240 Boundary Rd.
Marlboro, NJ 07746

Dear Mr. Bussey:

Thank you for your application for product registration of the ICC Flowtech drainage system products. The Department of Health, in accordance with Chapter 246-272A WAC, On-site Sewage Systems, has reviewed the information provided to us in your application for gravelless distribution product listing. This review has involved evaluations of ICC Flowtech FTS103H and FTS123H Drainage Systems. Based on the information contained in your application, these Flowtech products meet the requirements set forth in WAC 246-272A-0140 and -0145 to be placed on the List of Registered On-site Treatment and Distribution Products (Registered List).

Subject to this determination, the abovementioned Flowtech products will be placed on the Registered List as stated below.

Manufacturer/Contact Information	Product Name/Model	Type of Distribution Product
ICC Technologies 240 Boundary Road Marlboro, NJ 07746 Tel: (732) 683-9600 Fax: (732) 683-9911 E-mail: hbussey@atlanticbb.net Web: http://www.iccflowtech.com/	ICC Flowtech Drainage System FTS103H FTS123H	Gravel Substitute

Gravel Substitute Products						
Product / Model	Unit Size W / L / H (inches)	Void Space per foot^3 of media (cu. ft)	Void Space per arrangement of units (cu. ft)	Void Space per linear foot of trench (cu. ft)	Infiltrative Surface per arrangement of units (sq. ft.)	Infiltrative Surface per linear foot (sq. ft.)
ICC Flowtech Drainage Systems						
FTS103H	10" x 30" x 120" Horizontal arrangement of three 10" diameter "tubes" in a 30" wide trench.	0.4	7.2	0.72	25	2.5
FTS123H	12" x 36" x 120" Horizontal arrangement of three 12" diameter "tubes" in a 36" wide trench.	0.4	10.1	1.01	30	3.0

Please be advised that this registration expires on December 31 of each year. Manufacturers desiring to continue product registration must obtain department renewal according to the requirements in WAC 246-272A-0145(5). If the department finds the product has changed in any way that affects performance, it may not be renewed and must meet the requirements for initial registration.

If you have any questions, please contact me at (360) 236-3043 or by email at leslie.turner@doh.wa.gov.

Sincerely,

Leslie Turner
Leslie Turner
Wastewater Management Specialist

Cc: Environmental Health Directors
Sewage Program Coordinators

REPORT OF PERFORMANCE TESTING FOR FLOWTECH™ 12-INCH DRAINAGE PRODUCTS UNDER AASHTO H-10 LOADING CONDITIONS

H-10 Wheel Load Performance of Flowtech™ Drainage Products in Shallow Subgrade Drainage Applications

---

Prepared For:

Mr. Harry Bussey, III
ICC TECHNOLOGIES, INC.
240 Boundary Road
Marlboro, New Jersey 07746

~

Prepared By:

UNIFOUR ENGINEERING & TESTING LABORATORIES, P.C.
PO Box 2067
Hickory, North Carolina 28603

Unifour Job Number: 3091

~

June 15, 2007

NORTH CAROLINA PROFESSIONAL SEAL 19385 ENGINEER BOBBY L. BARNES

Bobby L. Barnes, PE
Principal Engineer
Registered, NC 19385

Unifour

2019 1st Avenue SW • Hickory, North Carolina 28601
P.O. Box 2067 • Hickory, NC 28603 • (P) 828.256.3000 (F) 828.256.6921

Engineering & Testing Laboratories, PC

TABLE OF CONTENTS

H-10 Wheel Load Performance of Flowtech™ Drainage Products in Shallow Subgrade Drainage Applications

1.0 INTRODUCTION

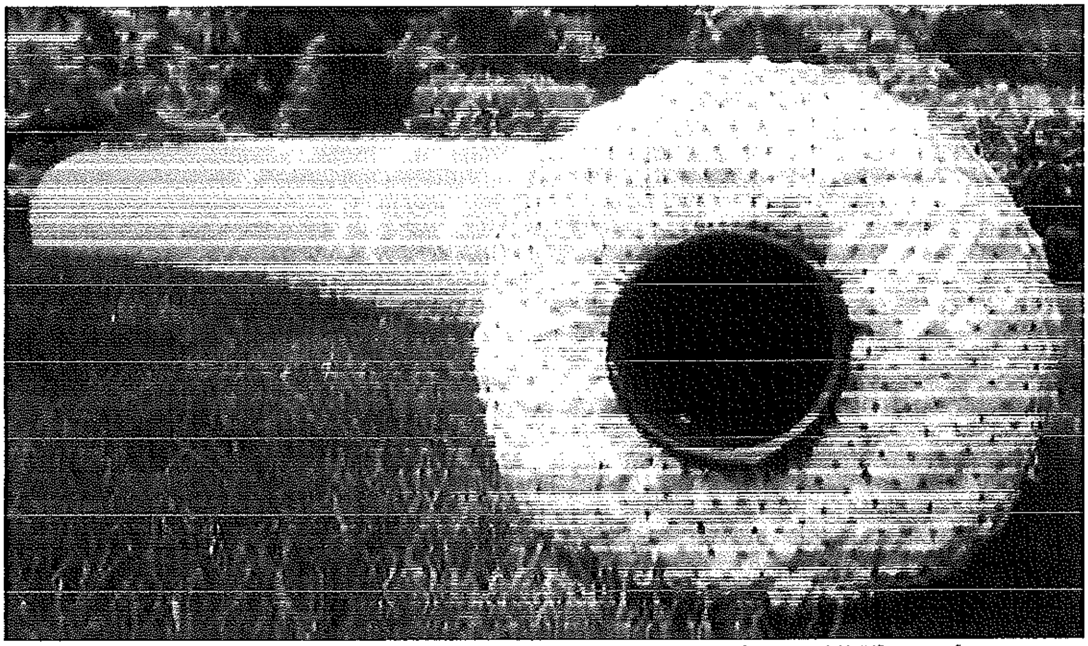
UNIFOUR ENGINEERING & TESTING LABORATORIES, P.C. (Unifour) has completed testing of the Flowtech™ 12-inch drainage products under controlled subgrade installation configurations followed by application of wheeled traffic loading. The purpose of the testing was to evaluate performance the drain products under subjection to H-10 wheel loads when installed in typical shallow subgrade drainage applications. Testing procedures were designed by Unifour's engineers to represent the in general accordance with the requirements established by the American Association of State Highway and Transportation Officials (AASHTO) for an application of standard H-10 load rating of 16,000 lbs per axle.

All opinions and conclusions presented within this report are based on facts, conditions, and observations existing at the time of the testing and on the products as delivered to us. No other representation is intended or implied.

2.0 PRODUCT BACKGROUND

The Flowtech™ drainage product is ICC Technologies, Inc.'s manufactured subsurface drainage solution to the construction industry's need for alternatives to conventional pipe and gravel drainage systems. The design of the Flowtech system utilizes lightweight, man-made polystyrene aggregate surrounding a perforated 4-inch corrugated plastic drain pipe and encased in either a polyethylene netting or non-woven geosynthetic filter fabric to produce a composite drainage product deliverable in 10-foot sections. Product sections can be coupled together for continuous open pipe flow using standard 4-inch plastic pipe internal compression couplings. Flowtech is manufactured currently in both 10-inch and 12-

inch outside effective diameter configurations, but it has been reported to us that additional sizes may soon be available.



Product Representation Photo used by Permission from ICC Flowtech

Details on the specific product components used in the manufacturing of Flowtech were supplied to Unifour and have been included as attachments to this report.

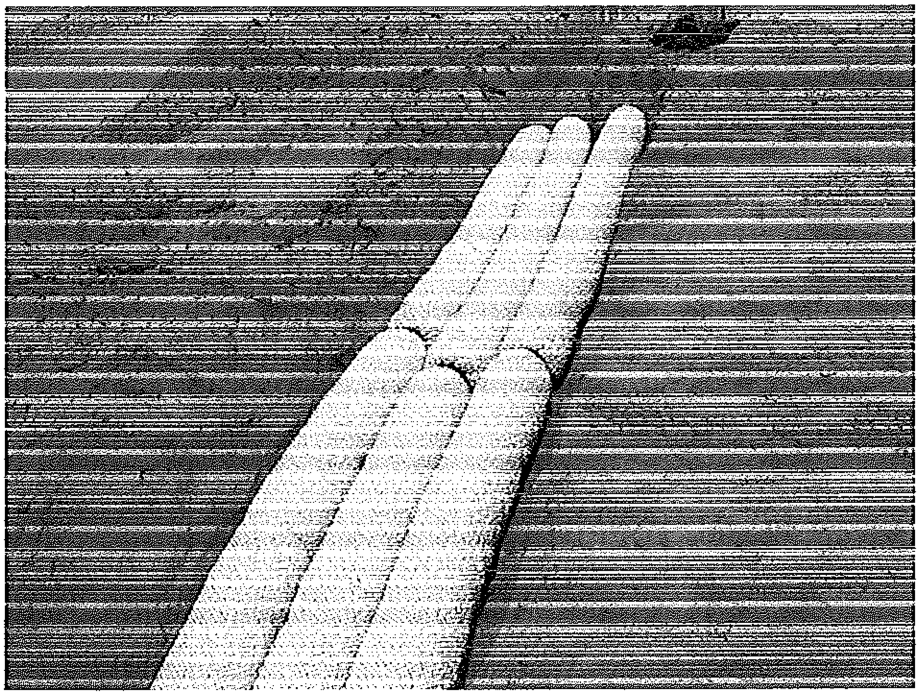
3.0 PRODUCT TESTING PROCEDURES

Unifour received delivery of several samples of Flowtech drainage product in both netting encased and fabric encased configurations. All samples used for our testing were nominal 12-inch diameter product. As mentioned in the introduction of this report, the purpose of the testing by the request of ICC Technologies, Inc. was to evaluate performance of the drain product under applied H-10 load rating as defined by AASHTO. The intention of the test was to determine if the Flowtech™ products could successfully withstand the load application when installed in typical shallow subgrade drainage configurations.

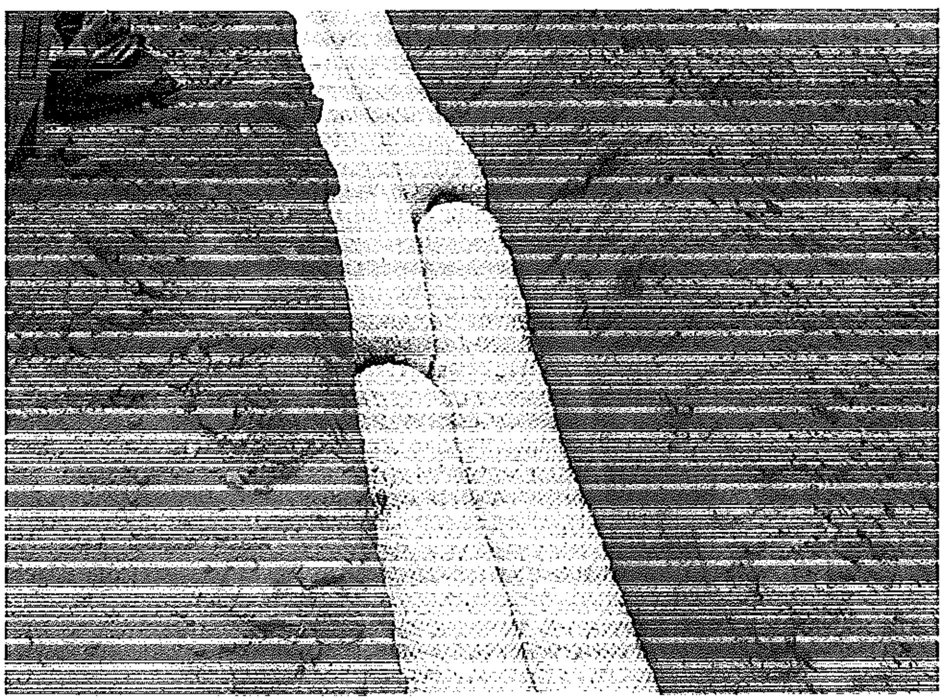
The objective of testing was to produce H-10 wheel loading conditions in general accordance with the guidelines established by AASHTO on each of the product cover configurations. All loads should be applied perpendicular to the alignment of the product installed in shallow subgrade configurations having a 12-inch compacted soil cover over the product. The results of testing could then be evaluated PASS/FAIL criteria, with failure being defined as collapse or breakage of the 4-inch corrugated plastic pipe. As a secondary objective, the observations made during and following testing were to assess the impacts of loading on the physical properties of the synthetic aggregate and the encasement materials.

The test setup consisted of the excavation of a series of shallow trenches of varied lengths typically between 20 and 25 feet and to widths of both 24 and 36 inches, based on whether a particular trench was to be used for the evaluation of a "2 Line" or "3 Line" configuration. Test trenches were established for "2 line" configurations using both the netting encased and the geosynthetic filter fabric encased drainage products. Trenching for the "3 line" configuration was prepared only for the netting encased product.

For purposes of uniformity, the test trenches were excavated into a controlled, mechanically placed structural soil fill pad that had been placed in nominal 8-inch lifts and compacted to a nominal 95% of the soil's maximum dry density as determined by ASTM D698 *Standard Proctor* methods. Standard trench excavation depth was set at 2 feet to provide sufficient depth for the 12-inch product and 12 inches of compacted backfill soils to re-establish approximately original grades. Structural fill soil depths, prepared as noted above, equaled or exceeded 5 feet within the test areas.



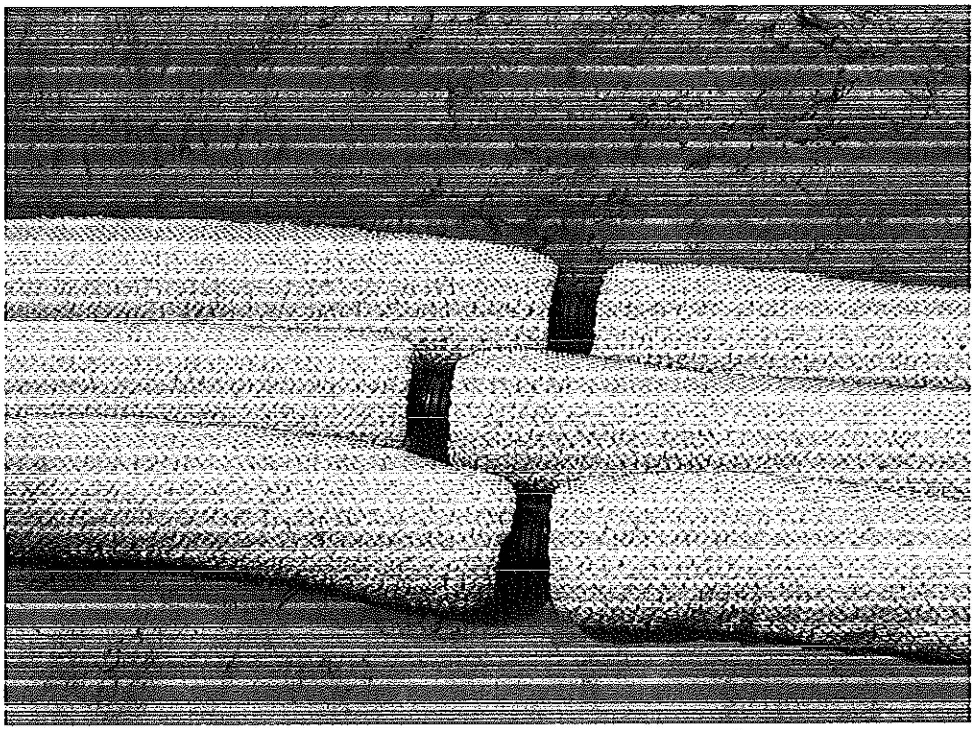
Typical 36" wide trench setup used for "3 line" configuration.



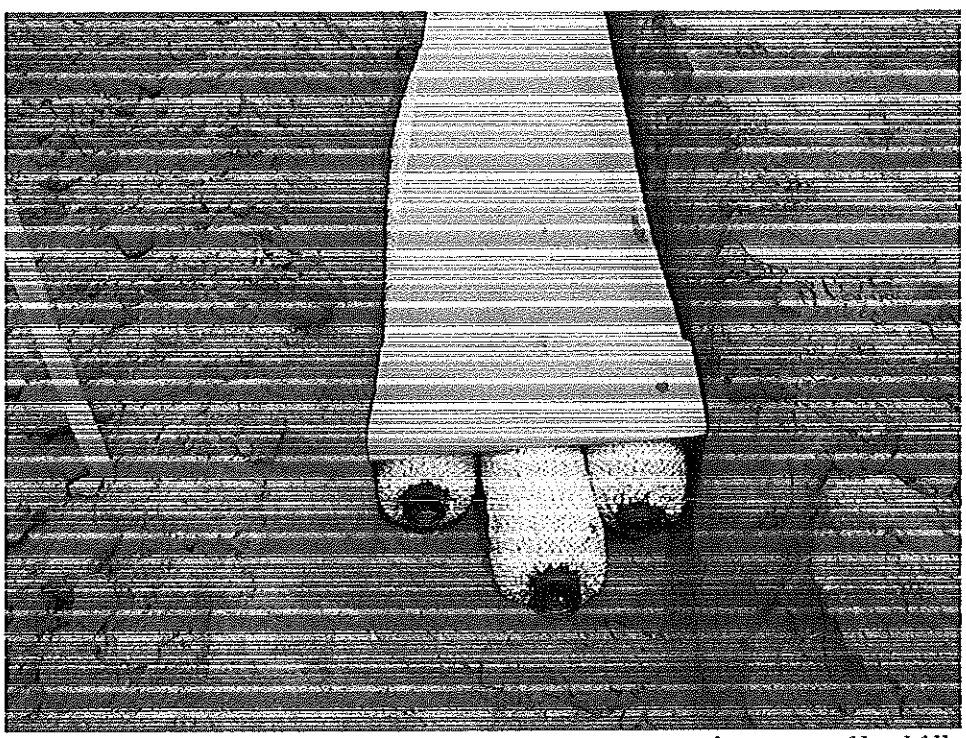
Typical 24" wide trench setup used for "2 line" configuration.

Once all trenches were excavated to the widths and lengths required, Unifour's personnel installed the various drainage product samples into their respective excavations. During the installation process, each piece of product was visually examined for any signs of prior damage that may have occurred during handling. Each pipe was viewed end to end for each sample to inspect for signs of existing compression or irregularity. Pipe diameters were measured for each sample. All pieces were determined to be free of visible defect and suitable for testing. Product sections were coupled together using standard 4-inch plastic pipe internal compression couplings per the manufacturer's recommendations. Joints between sections of adjacent lines were offset between 12 and 18 inches for trench stability purposes.

Prior to backfilling, the various product configurations in each of the trenches were covered with untreated 60-lb building paper. Standard paper roll width was 36 inches, so paper placed over product in a "2 line" configuration required the paper to be partially folded lengthwise. All trenches were backfilled with the soils excavated from the trenches using conventional equipment, placing the soil fill back into the trench over the products in two six-inch lifts and compacted using a vibratory plate tamp. Backfill was brought up above the products to a nominal depth of 12 inches, with finish grades dressed to approximately that of the existing grade adjacent to the trench sides. Staking was installed adjacent to the ends of each trench area and marked to identify product type and configuration within the respective trench.



"3 line" trench showing offset at section couplings.



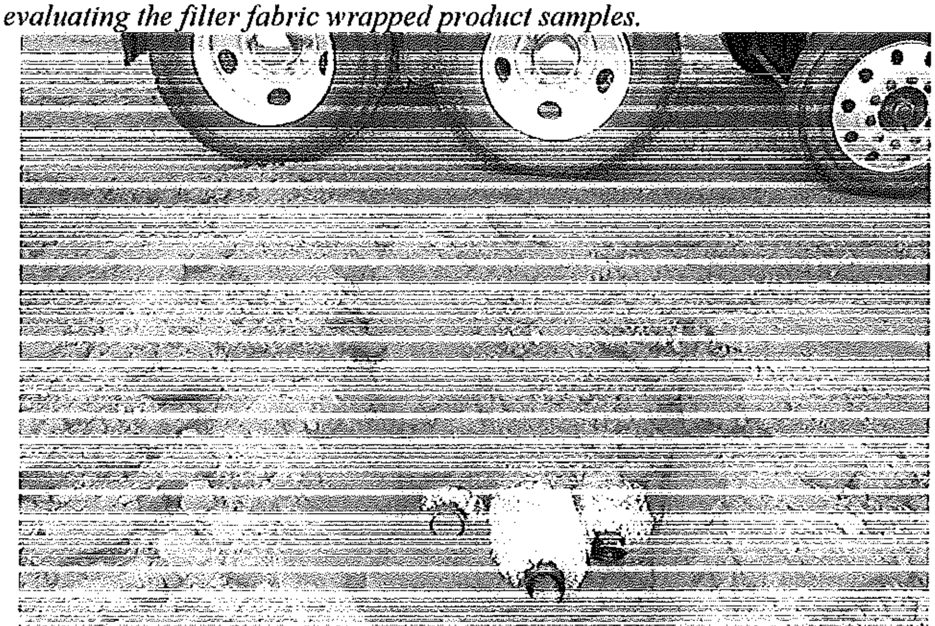
"3 line" trench showing construction paper covering prior to placement of backfill soils.

H-10 load application was accomplished using a standard quad axle dump truck. The truck was loaded with standard NCDOT Grade #57 washed stone at a local rock quarry nearby to the test site where the total gross weight of the truck and gravel was then recorded on the quarry's NCDOT certified scales. All weights were measured and recorded by an independent certified Weighmaster, with a printed receipt of the certified weight provided to Unifour's representative. Once the truck arrived at the test site, the driver was instructed to raise one of the trucks two auxiliary axles, leaving a total of four axles supporting the total vehicle and load weight. Total gross weight for the test truck was recorded at 66,900 pounds, distributing a total of 16,725 pounds to each of the four supporting axles.

Each trench configuration was subjected to four complete passes directly over the trench by the loaded test truck, with passes being perpendicular to the alignment of the trench. Passes were made in such as way that the wheel lines for the truck passed directly the mid-lines of each product bundle for two complete passes, then over the coupled section joints for the additional two complete passes. A complete pass is defined as passing all load-bearing axles completely over the entire trench. Following all trafficking passes, the loaded truck was sequentially parked over the centerline of each trench configuration such that the interior rear axle was stopped directly over each product bundle.

Once all loading passes had been completed, the products were exhumed from their respective trenches and visually examined for damage. The 4-inch pipe of each sample section was measured at the jointed ends.

Loaded truck shown making one of two complete passes over middle of the "2 line" test trench evaluating the filter fabric wrapped product samples.



View of loaded test truck parked with interior rear axle directly over "3 line" netting encased product bundle.

4.0 TEST RESULTS & DISCUSSION

The following presents Unifour's observations and discussion of the test data recorded for H-10 Wheel Load Performance of Flowtech™ Drainage Products in Shallow Subgrade Drainage Applications on both the Flowtech™ 12-inch drain product encased in netting and incased in geosynthetic filter fabric.

A full visual inspection of each tested sample was performed by Unifour's engineers after completion of loading and exhumation from their respective test trenches. Each sample was evaluated under the PASS/FAIL criteria established for the testing, with failure being defined as collapse or breakage of the 4-inch corrugated plastic pipe. As a secondary objective, each sample was evaluated by visual observations made during and following testing to assess the impacts of loading on the physical properties of the synthetic aggregate and the encasement materials.

All sample products tested were found to PASS under full application of H-10 loading as defined by AASHTO. The 4-inch pipe in all products were observed to be clear and unobstructed, necked or crushed end to end after exhumation as viewed end to end under daylight and indirect LED illumination. The diameters of each pipe end at the tested joint sections were measured post-loading and found to be nominally equal to the pre-test average measurements recorded on each sample. There were no visible signs of damage to either the couplings that connected the bundle sections, or to the encasement materials being either netting or fabric as applicable to each configuration. The test samples were observed to have deformed slightly from their installed circular cross-section to a shape more conforming to the test trench inverts; however, examination noted no physical damage to the synthetic aggregate.

All samples were given a PASSING rating of performance under H-10 loading.

5.0 CONCLUSIONS

Based on the observations and data collected during testing for Flowtech™ 12-inch drainage products under AASHTO H-10 Loading Application, Unifour developed the following conclusions:

- The Flowtech™ 12-inch drainage product encased both in netting and geosynthetic filter fabric are capable of sustaining AASHTO H-10 loading under shallow subgrade trench installations in "2 line" and "3 line" configurations with at least 12 inches of compacted backfill soil cover without failure.

Performance of Flowtech™ Drainage Products is considered acceptable for typical shallow subgrade drainage applications when subjected to H-10 equivalent loading as installed in trench configurations depth under loading parameters as defined by this test.

ATTACHMENTS

DISCLOSURE OF TESTING WEIGHT CERTIFICATION

Unifour Engineering & Testing Laboratories, PC (Unifour) has completed testing for preparation of a Report of Performance Testing For Flowtech™ 12-Inch Drainage Products under AASHTO H-10 Loading Conditions. The purpose of testing was to evaluate H-10 Wheel Load Performance of Flowtech™ Drainage Products in Shallow Subgrade Drainage Applications.

During the course of testing, the load vehicle used for this report was contracted from and the property of InSite Grading and Development, with corporate offices located in Hudson, NC.

Test load ballast was purchased from, and certified scales used to document test loads used were provided by Material Sales, Inc., South McDowell Quarry in Marion, NC.

Under standard Chain of Custody protocol, Unifour acknowledges direct receipt of the attached certified scale tare and gross load ticket, #10054 received 6/13/07 into Unifour's possession as received by:

NORTH CAROLINA PROFESSIONAL SEAL 19385 ENGINEER BOBBY L. BARNES

Date: 6/13/07 Time: 10:33 A

Bobby L. Barnes, PE

South McDowell Quarry
1182 Old Glenwood Road Marion, NC 28752 828-738-0332

TICKET # 10054
6/13/2007 10:10:36AM

CARRIER	IN	INSITE DEVELOPMENT
VEHICLE	812	812
CUSTOMER	45200	INSITE DEV.AND DESIGN
ORDER	00464	Burke Industrial Park
PO		
PRODUCT	055	#57 (3/4" washed)
WEIGHMASTER		Glenneth Shuping
RECEIVED BY		<signature on file>

Recipient acknowledges to accept full responsibility for delivery of this product and assumes full liability for overweight loads over their legal limit. Supplier is not responsible for damages or cost incurred resulting from delivery of our product.

	POUNDS	TONS	LOADS
GROSS	66,900	33.45	
TARE	26,400 *	13.20 *	
NET	40,500	20.25	
TODAY		20.25	1

* Predetermined Tare

	QTY	RATE	AMOUNT
PRODUCT	20.25 Ton		
FREIGHT			
TAX	XEMPT		
TOTAL			

ICC FLOWTECH™
DRAINAGE UNITS

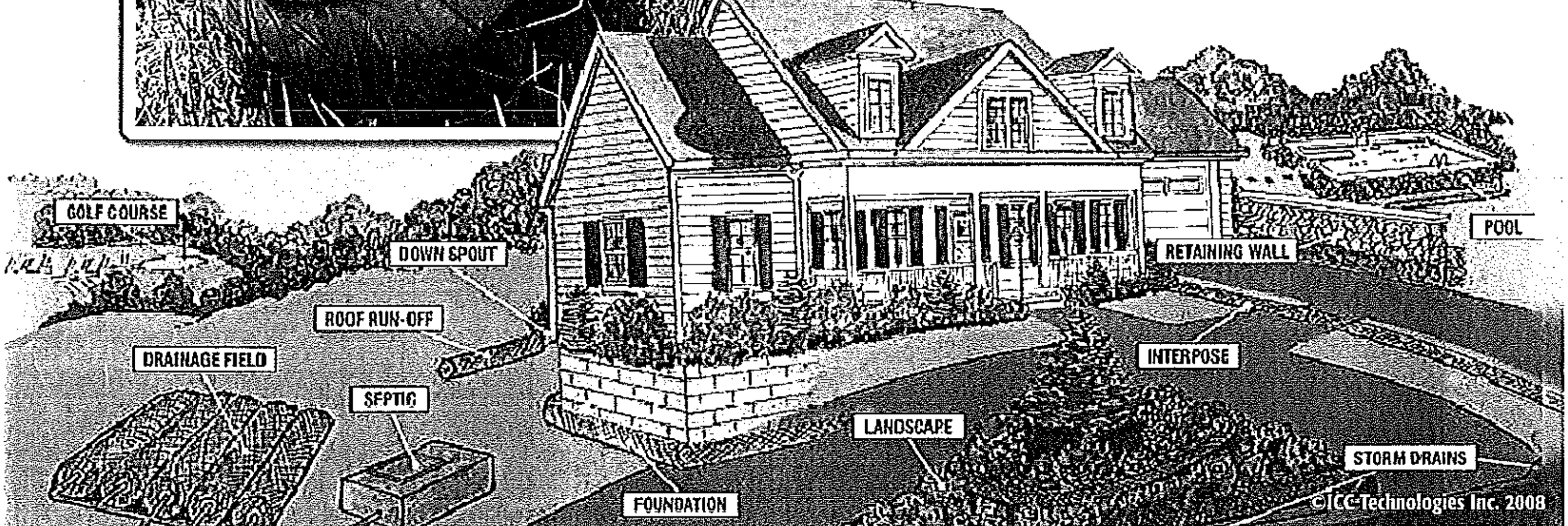
The Ultimate Drainage Solution

REPLACES GRAVEL 100%

- Reduces labor up to 50%
- No Fines • No Cleanup
- Reduces installation costs dramatically
- Complete unit ... Just put it in!!! Pipe centered in aggregate for easy installation.
- Couples together with ease
- Use with standard 4" fittings
- No installation guesswork like gravel ... just order the footage you need
- Reduce installation time by up to 50%
- More effective than gravel based on third party independent engineering reports

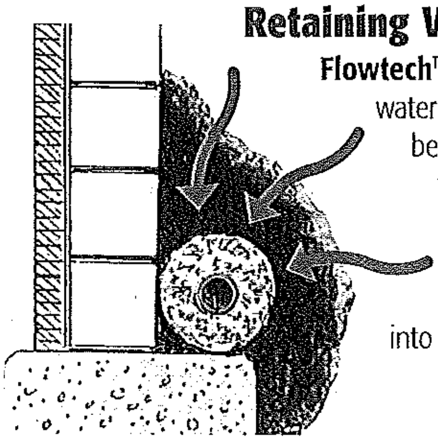
ICC Technologies, LLC
MARLBORO, N.J.

1-877-422-3569
www.ICCFLOWTECH.com



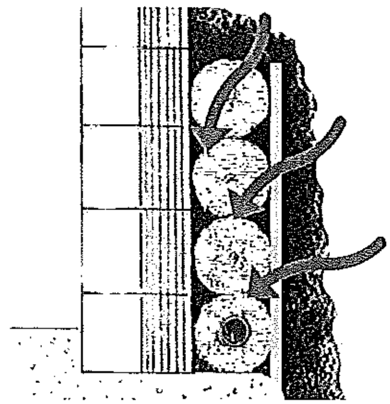
APPLICATIONS

Retaining Wall

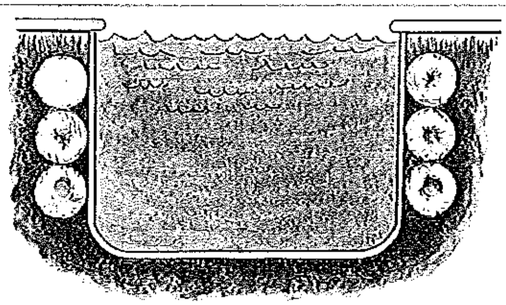


Flowtech™ reduces water buildup behind retaining walls and efficiently redistributes the water back into the soil.

Foundation Wall



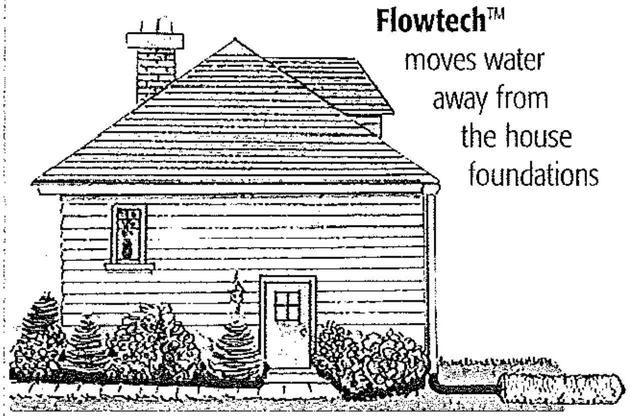
Flowtech™ directs water away from foundation walls to keep basement free of water and mildew.



Swimming Pools

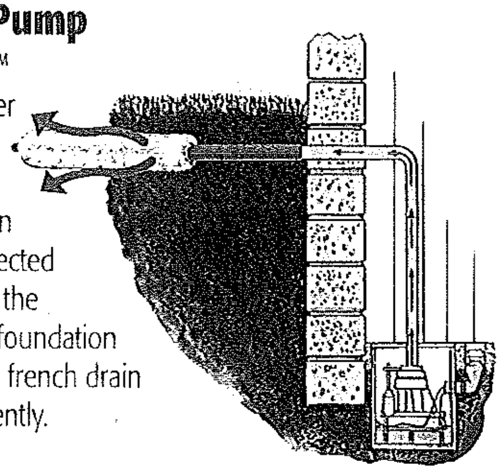
Flowtech™ channels excess water away from perimeter of pool to reduce static pressure and heaving from freeze.

Downspouts/Roof Runoff



Flowtech™ moves water away from the house foundations

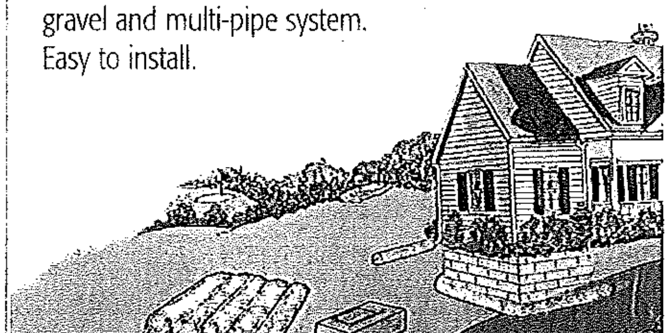
Sump Pump



Flowtech™ allows water removed from a french drain to be redirected away from the basement/foundation to help the french drain work efficiently.

Septic

Flowtech™ septic system is the ultimate in onsite septic systems compared to gravel and multi-pipe system. Easy to install.



REPORT OF DEFORMATION TESTING FOR FLOWTECH™ 12-INCH DRAINAGE PRODUCTS UNDER DIRECT VERTICAL SOIL LOAD CONDITIONS

Vertical Load Deformation Performance of Flowtech™ Drainage Products for Foundation and Retaining Wall Drain Use

---

Prepared For:

Mr. Harry Bussey, III
ICC TECHNOLOGIES, INC.
240 Boundary Road
Marlboro, New Jersey 07746

~

Prepared By:

UNIFOUR ENGINEERING & TESTING LABORATORIES, P.C.
PO Box 2067
Hickory, North Carolina 28603
Unifour Job Number: 3091

~

July 5, 2007

Bobby [illegible] Barnes
Principal Engineer
Registered, NC 19385

Unifour

2019 1st Avenue SW • Hickory, North Carolina 28601
P.O. Box 2067 • Hickory, NC 28603 • (P) 828.256.3000 (F) 828.256.6921

Engineering & Testing Laboratories, PC

TABLE OF CONTENTS

Vertical Load Deformation Performance of Flowtech™ Drainage Products for Foundation and Retaining Wall Drain Use

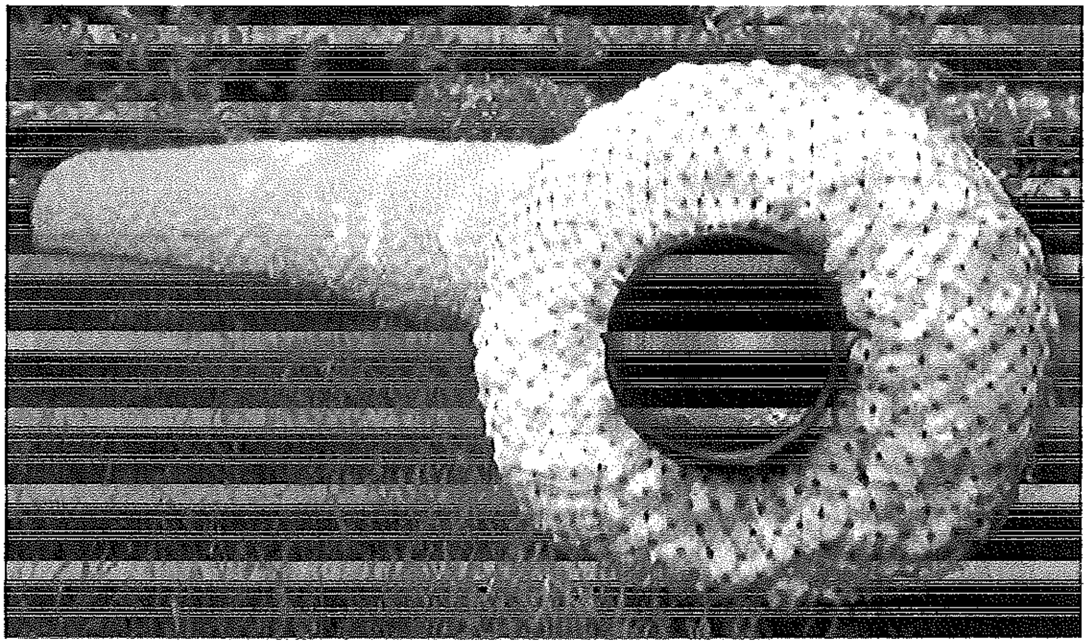
1.0 INTRODUCTION

UNIFOUR ENGINEERING & TESTING LABORATORIES, P.C. (Unifour) has completed testing of the Flowtech™ 12-inch drainage products under controlled vertical soil loading conditions by direct loading methods. The purpose of the testing was to evaluate deformation of the drain product under vertical soil load conditions that would likely be experienced during the use of the Flowtech™ 12-inch drainage products in foundation wall and retaining wall drain applications using narrow backfilled trenches. Testing equipment and procedures were designed by Unifour's engineers to represent the application of effective vertical soil loads that would be expected for equivalent backfill depth over the top of the product at up to 12 feet through the use of clean, dry soil backfill.

All opinions and conclusions presented within this report are based on facts, conditions, and observations existing at the time of the testing and on the products as delivered to us. No other representation is intended or implied.

2.0 PRODUCT BACKGROUND

The Flowtech™ drainage product is ICC Technologies, Inc.'s manufactured subsurface drainage solution to the construction industry's need for alternatives to conventional pipe and gravel drainage systems. The design of the Flowtech system utilizes lightweight, man-made polystyrene aggregate surrounding a perforated 4-inch corrugated plastic drain pipe and encased in either a polyethylene netting or non-woven geosynthetic filter fabric to produce a composite drainage product deliverable in 10-foot sections. Product sections can be coupled together for continuous open pipe flow using standard 4-inch plastic pipe internal compression couplings. Flowtech is manufactured currently in both 10-inch and 12-inch outside effective diameter configurations, but it has been reported to us that additional sizes may soon be available.



Product Representation Photo used by Permission from ICC Flowtech

Details on the specific product components used in the manufacturing of Flowtech were supplied to Unifour and have been included as attachments to this report.

3.0 PRODUCT TESTING PROCEDURES

Unifour received delivery of several samples of Flowtech drainage product in both netting encased and fabric encased configurations. All samples used for our testing were nominal 12-inch diameter product. As mentioned in the introduction of this report, the purpose of the testing by the request of ICC Technologies, Inc. was to evaluate deformation of the drain product under vertical soil load conditions that would likely be experienced during the use of the Flowtech™ 12-inch drainage products in foundation wall and retaining wall drain applications. The objectives of testing were to produce vertical loading conditions on each of the product cover configurations with all loads being applied axially to a confined sample section while measuring cumulative deformation of the sample as the loads were increased. The results of testing could then be evaluated under two specific criteria:

1. PASS/FAIL of the drainage composite under load, with failure being defined as collapse or breakage of the 4-inch corrugated plastic pipe and/or crushing of the overall pipe and synthetic aggregate system; and,
2. Reduction of overall drainage area cross-section and its implied affect on overall drainage performance.

It was determined by ICC to limit loading conditions to an equivalent maximum backfill height of 12 feet for this report. Testing equipment and procedures were designed by Unifour's engineers to represent the application of effective vertical soil loads that would be expected for equivalent backfill depth over the top of the product at up to 12 feet through the use of clean, dry soil backfill in a narrow, trench-like configuration that might be expected for typical retaining wall and foundation wall installations. Unifour elected to base loading criteria on use of locally available structural backfill soils representative by unit weight characteristics to soils typical for the region. The soils were verified to be relatively free of organic debris and root matter, since the use of organic-containing soils in structural backfill applications is generally considered unsuitable.

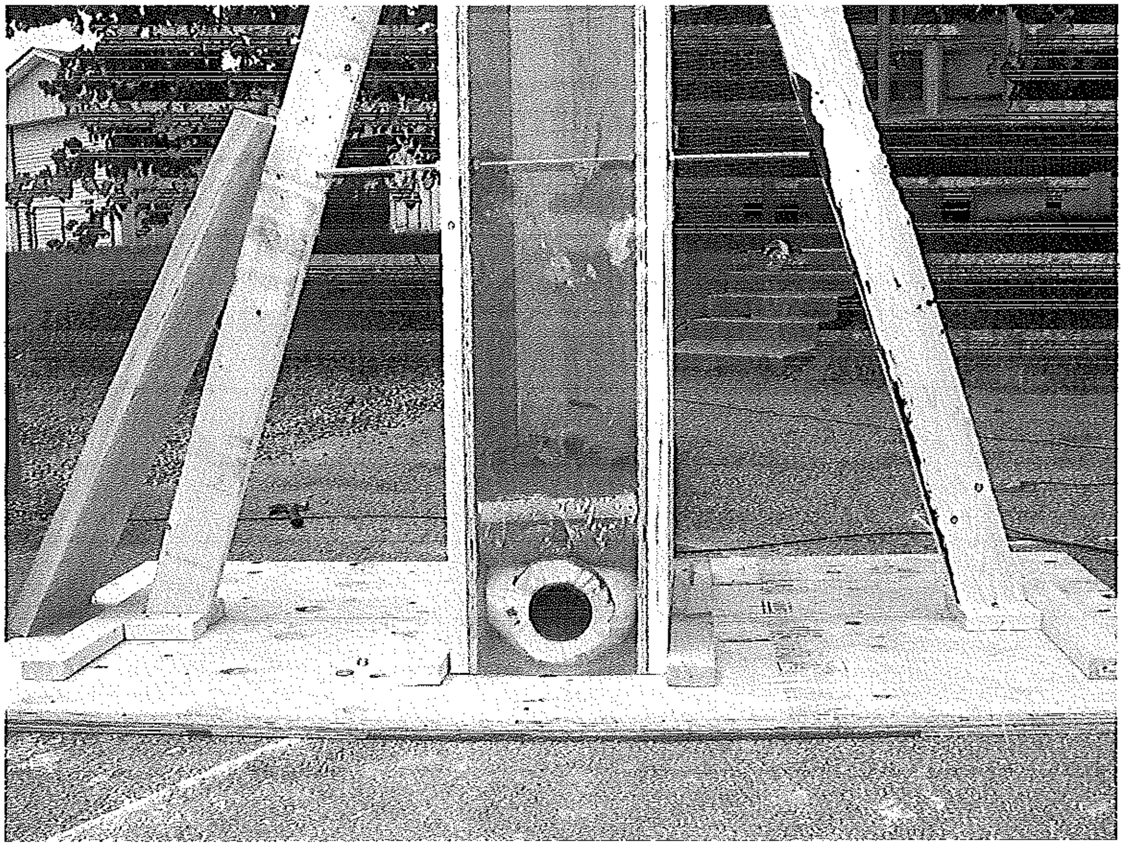
A test box and frame was built to a uniform width of 12 inches, being nominally 2 feet in length and an overall inside height of 13 feet. One of the box ends was faced with plywood sheeting, while the other end was faced with clear acrylic glass sheeting. The end closed with plywood sheeting was left with a 12-inch by

12-inch opening at the bottom to allow the full-length product sample to be inserted into the test box until it abutted the inside face of the acrylic.

Once the test sample was secured into the test box, the interior box walls directly above the sample were draped with doubled 6-mil transparent plastic sheeting, being sure to fully tuck in all edges to accurately conform to the shape of the product and its radius abutment with the test box side walls. Backfill soil was then placed along the edges of the sample until the product was completely covered, and continuing with additional backfill placement to produce a nominal 1-inch bedding for the loading platen. Doubling of the plastic sheeting provided for a near friction-free loading environment while allowing the backfill soils to fully conform to the shape of the product inside the box for uniform loading distribution.

The loading platen, consisting of a 2-inch thick hardwood plank was lowered into the box and centered along the sample. The hardwood was previously trimmed to fit accurately inside the box so as not to risk binding with the side or end walls while distributing the applied evenly and fully across the soil cover to the sample. Axial load was achieved by placing additional backfill soils directly into the test box by free-fall methods, then raking into a generally level surface.

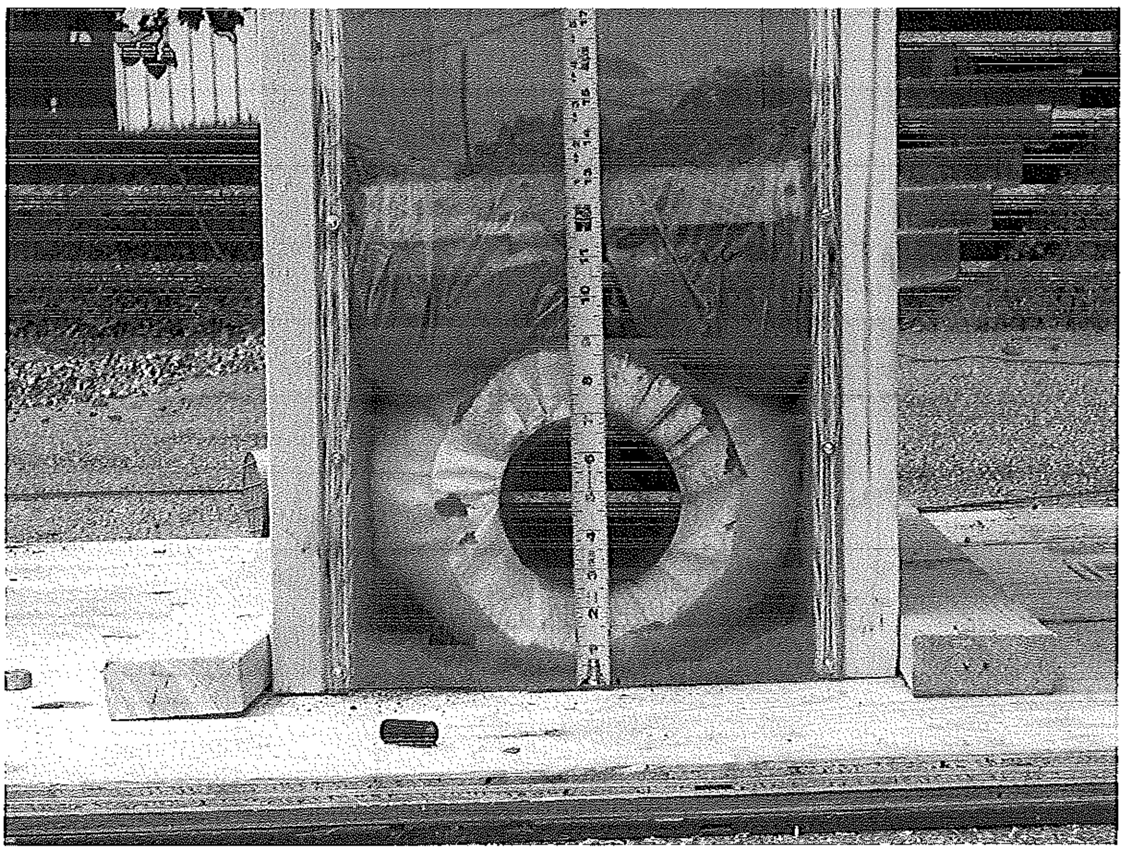
Test Box with fabric product sample installed & loading in place.



Fabric product with initial bedding soil and loading platen in place.

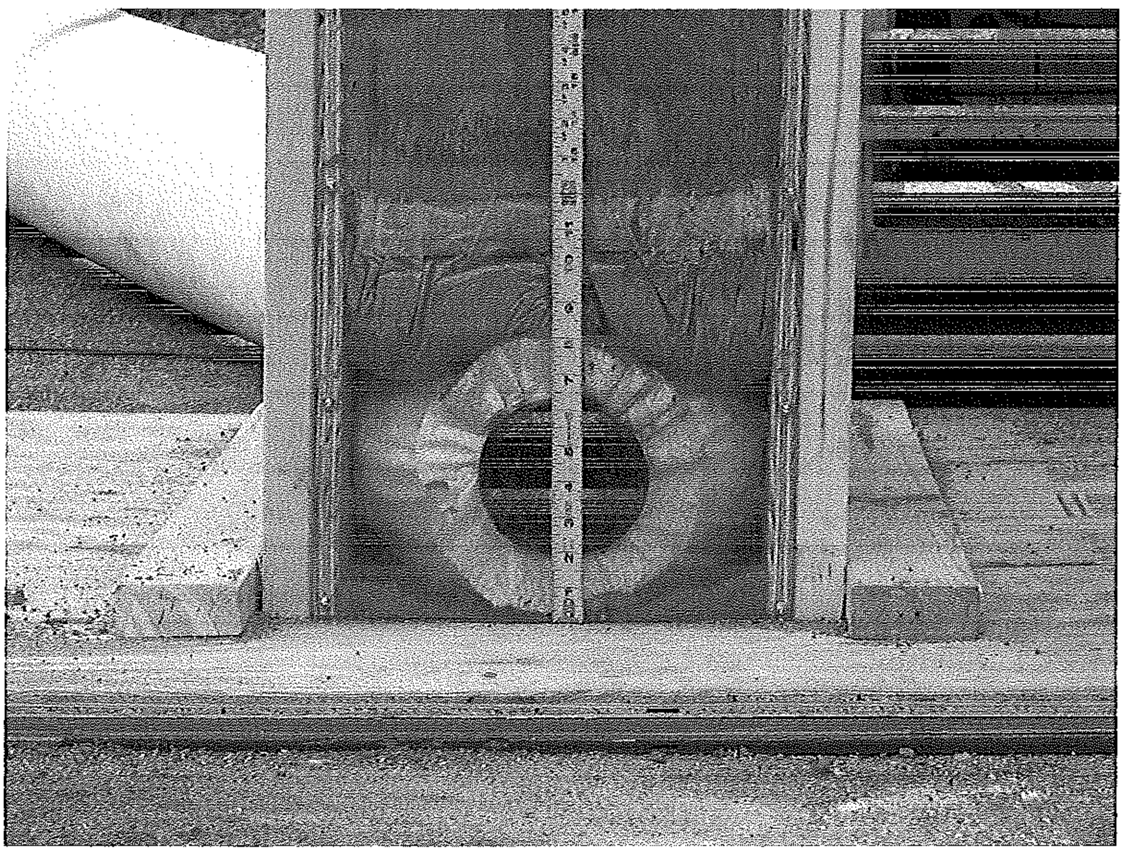
Backfill soils acquired from four local sources was evaluated for consistency to total unit weight when poured into a container of known volume and densified by tamping the container with a rubber mallet. Results of the evaluation determined that the local sources sampled had total unit weights ranging between 92.3 and 96.1 pounds per cubic foot (pcf). Repeated sampling and weighing of materials from each source concluded an average density of 95 pcf was appropriate for modeling the applied vertical load.

Backfill soils were placed and leveled in one foot depth increments to a maximum backfill height of 12 feet. Once a level soil surface was achieved at each load interval, the height of the drain product sample was recorded as visible through the acrylic glass end of the test box using a vertical ruler at the scribed centerline of the sample. Reference points for measurement were made at the base of the test box and at the invert horizontal edge of the loading platen. For purposes of data recording, it was assumed that any displacement of the platen was directly equal to the displacement experienced by the sample.



Fabric-encased sample at initial 1-ft backfill loading, showing vertical deflection measurement reference.

The loading process was repeated for each pre-determined one foot interval to maximum test loading. At the completion of all load interval measurements, the sample remained inside the test box at full load for one hour to verify that deformation had been fully stabilized. The integrity of the 4-inch plastic pipe could be viewed directly end-to-end through the acrylic glass to the exposed daylight end of the sample. Any observations of damage, collapse, crushing or breakage were noted on the sample test log. After final measurement and observation, the applied load was removed and the sample removed from the test box for full examination. As before, any damage was noted on the sample test log.



Fabric encased sample at full test load, showing vertical deflection measurement reference and noting fully intact and minimally deformed 4-inch plastic pipe.

4.0 TEST RESULTS & DISCUSSION

The following presents a tabulation and graphical representation of the test data recorded for deformation testing under equivalent vertical soil loading on both the Flowtech™ 12-inch drain product encased in netting and encased in geosynthetic filter fabric.

Flowtech™ 12-Inch w/ Netting Encasement: Deformation Under Direct Vertical Backfill Load

Backfill Cover Depth, Ft.	Applied Vertical Soil Load, PSF	Measured Centerline Vertical Sample Height, IN.	Cumulative Vertical Deflection, IN.	Gross Drainage Area Surface Reduction, %	Net Drainage Area Surface Reduction, %
0	0	11.875	-	0	0
1	100	11.563	0.313	0.72	0.72
2	200	11.375	0.5	1.45	1.45
3	300	10.938	0.937	3.68	3.68
4	400	10.75	1.125	4.81	4.55
5	500	10.5	1.375	6.45	4.78
6	600	10.25	1.625	8.23	4.96
7	700	10.25	1.625	8.23	4.96
8	800	10.25	1.625	8.23	4.96
9	900	10.25	1.625	8.23	4.96
10	1000	10.25	1.625	8.23	4.96
11	1100	10.25	1.625	8.23	4.96
12	1200	10.25	1.625	8.23	4.96

Flowtech™ 12-Inch w/ Fabric Encasement: Deformation Under Direct Vertical Backfill Load

Backfill Cover Depth, Ft.	Applied Vertical Soil Load, PSF	Measured Centerline Vertical Sample Height, IN.	Cumulative Vertical Deflection, IN.	Gross Drainage Area Surface Reduction, %	Net Drainage Area Surface Reduction, %
0	0	11.875	-	0	0
1	100	11.625	0.25	0.52	0.52
2	200	11.438	0.437	1.19	1.19
3	300	11	0.875	2.02	2.02
4	400	10.813	1.063	4.42	3.35
5	500	10.563	1.313	6.03	3.78
6	600	10.375	1.5	7.33	4.15
7	700	10.375	1.5	7.33	4.15
8	800	10.375	1.5	7.33	4.15
9	900	10.375	1.5	7.33	4.15
10	1000	10.375	1.5	7.33	4.15
11	1100	10.375	1.5	7.33	4.15
12	1200	10.375	1.5	7.33	4.15

Under evaluation Item #1: *PASS/FAIL of the drainage composite under load, with failure being defined as collapse or breakage of the 4-inch corrugated plastic pipe and/or crushing of the overall pipe and synthetic aggregate system*, both products were found to PASS under full load evaluation to a maximum backfill height of 12 feet. The 4-inch pipe in both products were observed to be clear and unobstructed, necked or crushed end to end under full load as viewed through the test box acrylic glass panel. On removal of the samples from the test box after loading, both samples were observed to be intact and undamaged with no signs of crushing to the synthetic aggregate system. Both samples did remain somewhat deformed to the squared shape of the test box invert, but overall cross-sectional area of the products was not significantly reduced from pre-loaded conditions. As a general observation, the pipe inside both samples compressed from a originally round shape to only slightly oval under full load with measured pipe wall deflection compressing less than ¼-inch top to bottom.

Under evaluation item #2: *Reduction of overall drainage area cross-section and its implied affect on overall drainage performance*, our observations noted that while deformation under full load allowed for a total vertical compression at the top of the samples on the order of 1.5 and 1.625 inches respectively for the fabric and netted products, the bottom of the samples tended to deform in to the beveled voids along the base of the test box. Accounting for the retention of sample area through deformation into the void space of the test box, the samples tested experienced less than 5 percent of net drainage area cross-section reduction. Therefore, its implied affect on overall drainage performance is not considered detrimental.

Comparisons of compression data for both products noted that deformation under load appeared to stabilize at a backfill depth of about 6 feet, with no additional deformation observed for either product up to the maximum tested backfill depth of 12 feet. Backfill soils placed in a narrow, confined column will develop friction/adhesion resistance against the sidewalls of a trench, and inter-particle stresses from slender columns of soils will likely create a "plug" whereby the weight of the column of soil is actually being carried in part or in whole by confinement itself. This phenomenon, commonly referred to as "soil arching", appears to have been similarly modeled by our test box. Occurrence of this phenomenon in our modeling suggests that designers may be able to account for some structural support of backfill columns in narrow trenches at depths greater than 12 feet without producing additional deformation stresses at the level of the drain product.

5.0 CONCLUSIONS

Based on the data collected during deformation testing for Flowtech™ 12-inch drainage products under vertical soil load conditions, Unifour developed the following conclusions:

- The Flowtech™ 12-inch drainage product encased both in netting and geosynthetic filter fabric are capable of sustaining equivalent vertical soil loads at up to 12 feet of backfill depth without failure.

- Deformation under full load as defined by testing for both the netting encased and the filter fabric encased Flowtech™ 12-inch drainage products is minimal with respect to net area cross-section reduction and its implied affect on overall drainage performance is considered non-detrimental.

- Vertical Load Deformation Performance of Flowtech™ Drainage Products is considered acceptable for foundation and retaining wall drain use at up to 12 feet of backfill depth under loading parameters as defined by this test.

Flowtech Product Specifications Calculations

Product Evaluation for Flowtech Standard 10-Inch, 12-Inch & 14-Inch EPS Synthetic Aggregate Drainage Product

The following example calculations are to show how the storage capacity of the 12-inch Standard drainage system, using three horizontally abutting, netted geosynthetic casings, one with drainage pipe and two without, was calculated. Tabulations of results obtained by measurement and calculation for each product follow this example.

The Product Tables (Tables 1 and 2) compare the different the Flowtech Drainage Systems with a Conventional Gravel System.

I. The following calculations are for a Conventional Gravel System, trench dimensions (trench 36in. by 14in. by 100 ft.), below invert elevation of 6 inches above bottom of trench:

Total Cross-sectional Area of Conventional System Trench = b x h

= (36 in. x 6 in.) / (144in^2)

=1.5 ft^2

Solids Volume Coefficient for Conventional System = 0.60

(Obtained by subtracting average void coefficient for gravel of 0.40 from 1.0)

Area of solids in trench below invert = A_s = A_c * % solids in trench

= 1.5 ft^2 * 0.60

= **0.90 ft^2**

Storage Volume = A_T - As

=1.5 ft^2 - 0.90 ft^2

= (0.60 ft^2) *(7.48 gal/ft^3)

=4.49 gal/ft

Storage Capacity of Conventional System = Storage Volume * Length of Trench

= 4.49 gal/ft * 100 ft

= 449 gallons

II. The following calculations are example calculations for the Flowtech 12-inch Prototype Offset Drain drainage system.

1. **Storage Volume** - This calculation uses the trench area, which is obtained by multiplying the trench width and the height of the invert of the drainage system, which is located in the center of the geosynthetic casing of the FLOWTECH drainage system. Unifour's laboratory testing confirmed the percentage of voids within the bulk aggregate in the drainage system to be 58.1%. To determine the total void space in a particular cross-section, it is best to calculate or measure the actual solids and space it occupies within that cross-section and then subtract the solids volume from the overall section area to determine the resultant void space remaining. The calculations below use the percent of solids in the drainage system, which was obtained by subtracting the percentage of voids measured in the bulk aggregate from 100%, to calculate the total area of solids in the trench. A solids percentage of 41.9% is used in calculations. The total area of solids (below the invert elevation) was subtracted from the total area of the trench (below the invert elevation) to give the total area of voids, which also equals the storage volume, when converted to gallons per linear foot.

The invert elevation of each of the FLOWTECH drainage systems is as follows:

- 10-inch diameter system = 3 inches off the trench bottom
- 12-inch diameter system = 4 inches off the trench bottom
- 14-inch diameter system = 5 inches off the trench bottom

Total Area of trench below invert of geosynthetic casing, $A_T = b * h$

$= (36 \text{ in.} * 4 \text{ in.}) / (144 \text{ in}^2/\text{ft}^2)$

$= \mathbf{1\ ft^2}$

Area of one geosynthetic casing, below the invert height of 4 inches = A_c = 33.0 in^2 = 0.229 ft^2 (Verified in AutoCAD, Release 2002)

Total area of geosynthetic casings below invert = $A_c * 3$

$= \mathbf{0.688\ ft^2}$

Area of solids in trench below invert = A_s = A_c * % solids in geosynthetic casings

$= 0.688 \text{ ft}^2 * 0.419$

$= \mathbf{0.288\ ft^2}$

Storage Volume = A_T - As

= 1 ft2 - 0.288 ft^2

$= (0.712 \text{ ft}^2) * (7.48 \text{ gal/ft}^3)$

= 5.33 gal/ft

2. **Linear Trench Feet Required** - This calculation takes the total storage capacity requirement of at least 449 gallons (conventional gravel system with a trench 36in. by 14in. by 100 ft.) and divides it by the storage volume of each alternate drainage system to determine an equivalent length of trench required for equal storage capacity. Again, the calculations use the example of three 12-inch standard drainage units. Tabulation for other sizes is provided.

   Required/Proposed Length of Trench = 449 gallons / storage volume

   = (449 gal) / (5.33 gal/ft)

   = 84.3 ft ≈ 85 ft

3. **Total Storage Capacity of Trench -** This calculation simply takes the required/proposed length of the trench and multiplies it by the storage volume of the drainage system.

Total Storage Capacity of Trench =

= Required/Proposed Length of Trench * Storage Volume

= (85 ft) * (5.33 gal/ft)

=453 gallons

4. **Storage Capacity (% of 3-ft conventional gravel system) -** This calculation is to ensure that storage capacity of the system is at least that available in a conventional gravel system, below the invert. To obtain it, simply divide the total storage capacity of the trench by the required storage capacity of the drainage system (449 gallons) and multiply by 100%.

Storage Capacity (% of 3-ft conventional gravel system) = (453 gal /449 gal) * 100%

= 101%

III. The following example calculations are to show how the trench bottom area of the 12-inch drainage system, using three geosynthetic casings, was calculated:

1. **Product Trench Bottom Width -** This is the width of the trench required for the proposed drainage system.

Product Trench Bottom Width = (36 in) / (12in/ft)

=3.0 ft

2. **Trench Bottom Area =** Length of trench * Product Trench Bottom Width

= 85 ft * 3.0 ft

=255ft^2

3. **Bottom Area (% of 3-ft gravel trench) -** This is a comparison of the proposed system bottom area to the bottom area of the 3-ft gravel trench.

Bottom Area (% of 3-ft gravel trench) = $(255\ ft^2 / 300\ ft^2) * 100\%$

$= \mathbf{85\%}$

4. **Product Sizing -** This calculation is to show the trench bottom width of a conventional gravel system that would be necessary to provide the same amount of storage area as the proposed drainage system.

Product Sizing = (Gravel Trench Bottom Area (ft^2)) / (FLOWTECH Trench Length (ft))

$= (300\ ft^2) / 85\ ft$

$= \mathbf{3.53}\ ft^2/ft$

Flowtech Product Specifications Calculations

Product Evaluation for Flowtech Prototype Offset Drain 12-Inch & 14-Inch EPS Synthetic Aggregate Drainage Product

The following example calculations are to show how the storage capacity of the 12-inch Prototype Offset Drain drainage system, using three horizontally abutting, netted geosynthetic casings, was calculated. Tabulations of results obtained by measurement and calculation for each product follow this example.

The Product Tables (Tables 1 and 2) compare the different the Flowtech Drainage Systems with a Conventional Gravel System.

I. The following calculations are for a Conventional Gravel System, trench dimensions (trench 36in. by 14in. by 100 ft.), below invert elevation of 6 inches above bottom of trench:

Total Cross-sectional Area of Conventional System Trench = b x h
= (36 in. x 6 in.) / ($144 in^2$)
=$1.5\ ft^2$

Solids Volume Coefficient for Conventional System = 0.60
(Obtained by subtracting average void coefficient for gravel of 0.40 from 1.0)

Area of solids in trench below invert = $A_s = A_c$ * % solids in trench
= $1.5\ ft^2 * 0.60$
= **$0.90\ ft^2$**

Storage Volume = A_T - As
=$1.5\ ft^2 - 0.90\ ft^2$
= ($0.60\ ft^2$) *($7.48\ gal/ft^3$)
= **4.49 gal/ft**

Storage Capacity = Storage Volume * Length of Trench
= 4.49 gal/ft * 100 ft
= **449 gallons**

II. The following calculations are example calculations for the Flowtech 12-inch Prototype Offset Drain drainage system.

1. **Storage Volume –** This calculation uses the trench area, which is obtained by multiplying the trench width and the height of the drain pipe invert of the drainage system, which is located at approximately 6 inches off of the bottom of the netted casing of the FLOWTECH drainage system as it rests on the excavated trench invert. Laboratory testing confirmed the percentage of interparticle voids in the bulk EPS synthetic aggregate of the drainage system to be 58.1%. The calculations below use the percent of solids in the drainage system, which was obtained by subtracting the percentage of voids from 100%, to calculate the total area of solids occupying space in the trench. A solids percentage of 41.9% is used in calculations. The total area of solids (below the invert elevation) was subtracted from the total area of the trench (below the invert elevation) to give the net area of voids, which also equals the storage volume, when converted to gallons per linear foot.

The invert elevations of each of the FLOWTECH drainage systems are as follows:

- 12-inch diameter system = 6 inches off the trench bottom
- 14-inch diameter system = 6 inches off the trench bottom

Total Area of trench below invert of drain pipe, A_T = b *h
= (36 in. * 6 in.) / (144 in^2/ft^2)
= 1.5 ft^2

Area of one fabric casing, below the invert height of 6 inches = A_C = 0.393 ft^2
(Verified in AutoCAD, Release 2002)

Total area of fabric casings below invert = A_C*3
= 1.18 ft^2

Area of solids in trench below invert = $A_s = A_D$ * % solids in fabric casings

= 1.18 ft^2 * 0.419

= 0.494 ft^2

Storage Volume = $A_T - A_s$

= 1.5 ft^2 - 0494 ft^2

= (1.01 ft^2) * (7.48 gal/ft^3)

= 7.52 gal/ft

2. **Linear Trench Feet Required** – This calculation takes the total storage capacity requirement of at least 449 gallons (conventional gravel system with a trench 36in. by 14in. by 100 ft.) and divides it by the storage volume of each drainage system.

Required/Proposed Length of Trench = 449 gallons / storage volume

= (449 gal) / (7.52 gal/ft)

= 59.7 ft ≈ 60 ft*

*Note: A length of 70 feet was required to obtain the bottom area requirement of at least 67% of the 3-ft conventional gravel system.

3. **Total Storage Capacity of Trench** – This calculation simply takes the required/proposed length of the trench and multiplies it by the storage volume of the drainage system.

Total Storage Capacity of Trench =

= Required/Proposed Length of Trench * Storage Volume

= (70 ft) * (7.52 gal/ft)

= 526 gallons

4. **Storage Capacity (% of 3-ft conventional gravel system) –** This calculation is to ensure that storage capacity of the system is at least that available in a conventional gravel system, below the invert. To obtain it, simply divide the total storage capacity of the trench by the required storage capacity of the drainage system (449 gallons) and multiply by 100%.

Storage Capacity (% of 3-ft conventional gravel system) = (526 gal / 449 gal) * 100%

= 117%

III. The following example calculations are to show how the trench bottom area of the 12-inch drainage system, using three fabric casings, was calculated:

1. **Product Trench Bottom Width** – This is the width of the trench required for the proposed drainage system.

Product Trench Bottom Width = (36 in) / (12in/ft)

= 3.0 ft

2. **Trench Bottom Area** – Length of trench * Product Trench Bottom Width

= 70 ft * 3.0 ft

= 210 ft^2

3. **Bottom Area (% of 3-ft gravel trench) –** This is a comparison of the proposed system bottom area to the bottom area of the 3-ft gravel trench.

Bottom Area (% of 3-ft gravel trench) = (210 ft^2 / 300 ft^2) * 100%

= 70%

4. **Product Sizing** – This calculation is to show the trench bottom width of a conventional gravel system that would be necessary to provide the same amount of storage area as the proposed drainage system.

Product Sizing = (Gravel Trench Bottom Area (ft^2)) / (FLOWTECH Trench Length (ft))

= (300 ft^2) / 70 ft

= 4.29 ft^2/ft

September 3, 2007

Mr. Harry Bussey, III
ICC Technologies, Inc.
240 Boundary Road
Marlboro, New Jersey 07746

Subject: Comparison of Flowtech® Synthetic Aggregate to Gravel Aggregate
Report on Trench Invert and Sidewall Effective Drainage Area

Dear Mr. Bussey,

Within the course of our evaluation of the Flowtech products under various testing parameters, a question has developed regarding the available storage space available within the synthetic aggregate system and its comparative affect on exposed soil drainage area within the invert and sidewalls of conventional gravel-filled soil drainage trenches. .To that end, Unifour has conducted an evaluation of available void space within the aggregate systems and the effective drainage area available at the aggregate/soil interface.

The traditional method for comparison of infiltration systems is to default to comparing the hydraulic performance of its components through the use of Darcy's law. Darcy's Law is accepted as the soil physics principal of how saturated flow through a permeable media operates, and is generally presented as:

Q = KIA

Where;
Q = Flow Rate of Effluent (gpd)
K = Hydraulic Conductivity of the Media (gpd/ft^2)
I = Hydraulic Gradient
A = Area for Effluent Transmission (ft^2)
I = H/L
H = Hydraulic Head Length (ft)
L = Length of Media (ft)

Regulatory agencies have often inferred that the flow rate (Q) of a gravel system is directly proportional to the cross sectional area of the drainfield not covered by stone, whereby the area of soil in direct contact with the stone is not considered as available drainage area due to the conditions known as "gravel masking" or "stone shadowing". The remaining area available that is not in direct contact with aggregate is, therefore, the net or effective drainage area available for effluent infiltration.

Unifour
2019 1st Avenue SW • Hickory, North Carolina 28601
P.O. Box 2067 • Hickory, NC 28603 • (P) 828.256.3000 (F) 828.256.6921
Engineering & Testing Laboratories, PC

To evaluate effective drainage area between an aggregate and its interface with the invert and sidewalls of a trench, one must first evaluate the gradation and void ratio of the aggregate itself. It is the void space in the aggregate the determines its net storage volume. For purposes of this evaluation, the Flowtech synthetic aggregate was compared by direct measurement of specific gravity and bulk density to DOT Grade #57 gravel, which is typically used as the aggregate component in conventional effluent disposal trench construction.

By definition, all volumes and weights of matter can be represented as the summation of volume and weight for each of three phases – solids, liquids and air. Devoid of liquids, this is reduced further to solids and air only. Since any porous media capable of allowing water to flow through it can have all volumes occupied by air to be filled with water in a saturated state, the volume of voids, or summation of the void spaces between the solid particles in a matter, can be considered to be its storage volume available for water.

Computational relationships are well established in the relationship between volumes and masses (or weight). One important relationship is the specific gravity of the solids, G_s. This is expressed as:

$$G_s = W_s / (V_s)(\rho_{water})$$

Where;
$\mathbf{W_s}$ = Weight of solids
$\mathbf{V_s}$ = Volume of solids
ρ_{water} = Unit weight of water (accepted at 62.4 pounds per cubic foot)

Unifour performed laboratory testing of the natural gravel aggregate and the synthetic aggregate materials under the following standardized procedures:

ASTM C127-04 "Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate"

ASTM C29/C29M-97(2003) "Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate"

Results of testing are reported below:
ASTM C127-04:

Flowtech Synthetic Aggregate
Bulk Dry Specific Gravity as sampled - 0.023
Apparent Density - 1.42 pounds per ft^3 (pcf)

Gravel Aggregate
Bulk Dry Specific Gravity as sampled - 2.73
Apparent Density - 170.35 pounds per ft^3 (pcf)

ASTM C29/C29M-97(2003):

Flowtech Synthetic Aggregate

Unit Weight as sampled	- 0.651 pcf
By reduction:	
Volume of Solids, V_s	- 0.454 ft^3
Volume of Solids, V_v	- 0.546 ft^3

Gravel Aggregate

Unit Weight as sampled	- 128.26 pcf
By reduction:	
Volume of Solids, V_s	- 0.753 ft^3
Volume of Voids, V_v	- 0.247 ft^3

By comparison of the volume of voids within each of the two different aggregates, the storage space available for water in the natural gravel tested would be a nominal 1.87 gallons per cubic feet of stone, while the Flowtech synthetic aggregate provides a storage space available at nominally 4 gallons per cubic foot of synthetic aggregate. Further testing of both aggregates under loaded conditions representing 12 inches of soil cover as might be expected in a trench application found both aggregates to loose approximately 0.5% of available storage space. The synthetic aggregate's loss was obrserved to be principally due to deformation and compression of the aggregate particles, while the natural aggregate was observed to be principally due to the imbedding and compression of the aggregate into the soils at their interface. No additional imbedding was observed for the synthetic aggregate under loading. This most likely can be attributed to its confinement within an open netting that serves to reinforce and bridge the interface contact areas.

Conclusion

By a direct comparison of the resulting test data, it is our conclusion that the Flowtech synthetic aggregate maintained an available storage space in excess of 2 times that of that available using natural #57 graded gravel aggregate. Further, when measuring available void space and extrapolating the percentage of volume available for solids to be in contact with soils at the trench wall and invert interfaces, it is our conclusion that the Flowtech synthetic aggregate provides at least an equal effective drainage area in comparison to the graded gravel, and typically provides an increased effective drainage area of between 1.5 and 2 times that of graded gravel.

We appreciate the opportunity to provide this evaluation for you

Respectfully submitted,

UNIFOUR ENGINEERING & TESTING LABORATORIES, PC

Bobby L. Barnes, PE
Principal Engineer
Registered, NC 19385

September 3, 2007

Mr. Harry Bussey, III
ICC Technologies, Inc.
240 Boundary Road
Marlboro, New Jersey 07746

Subject: Comparison of Flowtech® Synthetic Aggregate to Gravel Aggregate
Report on As-Tested Hydraulic Conductivity Under Soil Surcharge

Dear Mr. Bussey,

Thank you for providing us with several samples of your product for evaluation. Within your request for evaluation of product, you asked that Unifour disassemble random samples of the netted product and test the synthetic aggregate for hydraulic conductivity in comparison to natural gravel aggregate. The intent of this comparison was to evaluate the effects on infiltration of water into a soil media, such as in a drainage trench.

No designated standard for testing, or standardized procedures, were specified for testing. Rather, the direction was given by a reviewing regulatory agency representative that the testing be performed in a manner to simulate the presence of aggregate in direct contact with soils as would be the case in a drainage trench invert, then subject the aggregate to loading equivalent to a nominal one foot of soil cover. Standardized C33 Sand was determined to be acceptable as a representative soil for comparative testing purposes.

The objective of testing was to produce an environment in which the quantifiable flow of water under low head could be obtained for equal volumes and cross-sectional areas without producing a situation of turbulent flow. The test setup consisted of a stationary panel onto which was mounted an acrylic glass cylinder open at each end. The cylinder had an average interior diameter at 5.75 inches, having equivalent open end areas of 0.180 square feet. Overall cylinder length was 14 inches. Wire mesh screen graded to sufficiently retain the test soil was affixed across the bottom opening of each cylinder and reinforced with 3/8 inch woven wire grid to reinforce the mesh. Mounted directly into the center of the open cylinder was ¾-inch PVC plumbing to provide supply water via connection to a pressurized water supply source at Unifour's laboratory. Flow through the PVC plumbing could be regulated by way of an in-line ball valve, with water transferred into the chamber through dispersing tubes directly into the aggregate layer. Flow into the chamber was restricted and dispersed to prevent a concentrated flow from creating an agitating or turbulent condition that could introduce trapped air into the samples.

Unifour
2019 1st Avenue SW • Hickory, North Carolina 28601
P.O. Box 2067 • Hickory, NC 28603 • (P) 828.256.3000 (F) 828.256.6921
Engineering & Testing Laboratories, PC

Prior to introducing any test materials into the chambers, the threshold flow rate of the test system was verified. This step was performed to be sure that the chamber itself did not provide any restrictions to flow that could influence the conductivity measurements of the samples themselves. The water supply was turned on to its maximum flow rate, and it was observed that the chamber allowed the full flow to pass through freely without building up any water level inside the chamber. Also, this step allowed Unifour personnel an opportunity to verify the repeatability of our flow measurement methods. Flow measurements were made by collecting all flow out of the bottom of the chamber for a recorded amount of time into an empty container of known tare weight. The container with the collected water was weighed to determine the net weight of water that passed through the chamber and into the collector over the recorded time interval. This process was repeated several times for each chamber to verify repeatability of the sampling methods and to determine if any significant fluctuations existed in the supply flow. Maximum flow rates ranged between 113.7 and 114.6 pounds per minute and averaged at 114.2 pounds per minute (13.69 gallons per minute).

Testing of the drainage materials were arranged in the following configurations:

- ASTM C33 screened and washed concrete masonry sand; 3 inches of sand in the bottom of the chamber to represent the soil invert.
- Drainage aggregate, being either NCDOT Grade #57 gravel aggregate (w/ max. 0.6% fines by specification) or Flowtech Synthetic Aggregate;, 6 inches of gravel in chamber directly above the initial soil layer.
- Aggregate separation media, being conventional construction grade paper typically used to cover aggregate trench systems prior to backfilling with soils.
- Cover soils over the aggregate and paper, being 6 inches of ASTM C33 sand with an additionally applied static weight above the sand to equate to a loading of at least 12 inches of backfill at a soil unit weight of 100 pounds per cubic foot.

After each sample configuration was placed into the test chamber, the first step of the test was to develop a steady state flow condition within each chamber using a marked line at a fixed height above the bottom of the chamber at which to maintain a constant water level inside the chamber. Supply water flow was gradually increased until a water level began to stage up inside the chamber. Once the water level inside the chamber had reached the reference mark and completely submerged the aggregate zone within the test sample configuration, the supply flow was reduced. Over a period of 15 minutes, the supply valve was repeatedly adjusted as necessary to establish a flow rate that would maintain the water level inside the chamber at the constant marked reference line.

Once steady state flow was established and the 15 minute hold time had elapsed, our personnel began a sequence of measuring flow rates by the method described previously. Each sample configuration was tested six times, with the data recorded for averaging and determination of standard deviation.

The following presents Unifour's observations and discussion of the test data recorded for comparative evaluation of the Flowtech™ synthetic aggregate to conventional sand and gravel drainage media with respect to hydraulic conductivity under saturated, steady state flow characteristics.

Q (flow in lbs./min)								
Device	Trial #1	Trial #2	Trial #3	Trial #4	Trial #5	Trial #6	Mean	Std. Dev.
57 Stone Gravel (6") over Sand	0.45	0.43	0.44	0.45	0.46	0.47	0.45	0.014
Flowtech Agg. (6") over sand	1.62	1.58	1.64	1.60	1.60	1.59	1.61	0.022

Q (flow in gal./min)								
Device	Trial #1	Trial #2	Trial #3	Trial #4	Trial #5	Trial #6	Mean	Std. Dev.
57 Stone Gravel (6") over sand	0.05	0.05	0.05	0.05	0.06	0.06	0.054	0.002
Flowtech Agg. (6")over sand	0.19	0.19	0.20	0.19	0.19	0.19	0.192	0.003

HYDRAULIC CONDUCTIVITY COMPARISON					
Device	Q Flow (GPM avg.)	L Length of sample (ft)	H Head of Water (ft.)	A, Surface Area of Chamber (ft^2)	K_{sat} Saturated Conductivity (gpm/ft^2)
57 Stone Gravel (6") over sand	0.054	0.67	0.667	0.18	0.300
Flowtech Agg. (6") over sand	0.192	0.67	0.667	0.18	1.067

Conclusion

By a direct comparison of the resulting test data, it is our conclusion that the Flowtech synthetic aggregate maintained a steady state flow in excess of 3 times the rate achieved using natural #57 graded gravel aggregate when measuring infiltration rates into an aggregate/soil interface.

We appreciate the opportunity to provide this evaluation for you

Respectfully submitted,

UNIFOUR ENGINEERING & TESTING LABORATORIES, PC

NORTH CAROLINA PROFESSIONAL SEAL 19385 ENGINEER BOBBY L. BARNES

Bobby L. Barnes, PE
Principal Engineer
Registered, NC 19385

Designation: D 1621 – 04a

Standard Test Method for
Compressive Properties Of Rigid Cellular Plastics[1]

This standard is issued under the fixed designation D 1621; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method describes a procedure for determining the compressive properties of rigid cellular materials, particularly expanded plastics.

1.2 The values stated in SI units are to be regarded as the standard. The values in brackets are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This test method and ISO 844 are technically equivalent.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 618 Practice for Conditioning Plastics for Testing

E 4 Practices for Force Verification of Testing Machines

E 83 Practice for Verification and Classification of Extensometer Systems

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *ISO Standard:*

ISO 844 Cellular Plastics—Compression Test of Rigid Materials[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *compliance*—the displacement difference between test machine drive system displacement values and actual specimen displacement.

3.1.2 *compliance correction*—an analytical method of modifying test instrument displacement values to eliminate the amount of that measurement attributed to test instrument compliance.

3.1.3 *compressive deformation*—the decrease in length produced in the gage length of the test specimen by a compressive load expressed in units of length.

3.1.4 *compressive strain*—the dimensionless ratio of compressive deformation to the gage length of the test specimen or the change in length per unit of original length along the longitudinal axis.

3.1.5 *compressive strength*—the stress at the yield point if a yield point occurs before 10 % deformation (as in Fig. 1a) or, in the absence of such a yield point, the stress at 10 % deformation (as in Fig. 1b).

3.1.6 *compressive stress (nominal)*—the compressive load per unit area of minimum original cross section within the gage boundaries, carried by the test specimen at any given moment, expressed in force per unit area.

3.1.7 *compressive stress-strain diagram*—a diagram in which values of compressive stress are plotted as ordinates against corresponding values of compressive strain as abscissas.

3.1.8 *compressive yield point*—the first point on the stress-strain diagram at which an increase in strain occurs without an increase in stress.

3.1.9 *deflectometer*—a device used to sense the compressive deflection of the specimen by direct measurement of the distance between the compression platens.

3.1.10 *displacement*—compression platen movement after the platens contact the specimen, expressed in millimetres or inches.

3.1.11 *gage length*—the initial measured thickness of the test specimen expressed in units of length.

3.1.12 *modulus of elasticity*—the ratio of stress (nominal) to corresponding strain below the proportional limit of a material expressed in force per unit area based on the minimum initial cross-sectional area.

---

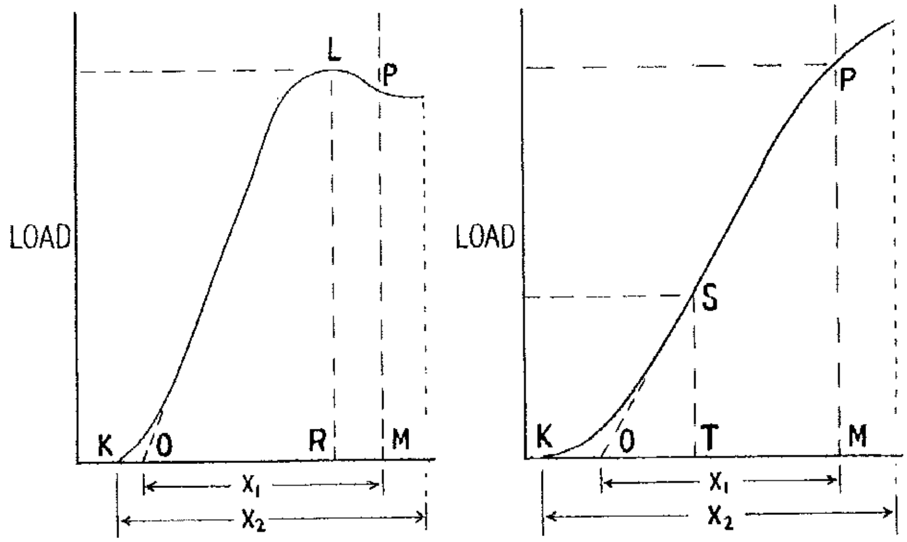
[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.22 on Cellular Plastics.

Current edition approved October 1, 2004. Published October 2004. Originally approved in 1959. Last previous edition approved in 2004 as D 1621 - 04.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

*A Summary of Changes section appears at the end of this standard.



X_1 = 10 % CORE DEFORMATION
X_2 = DEFLECTION (APPROXIMATELY 13 %)

FIG. 1 a Compressive Strength (See 3.1.5 and Section 9) **FIG. 1 b Compressive Strength (See 3.1.5 and Section 9)**

3.1.13 *proportional limit*—the greatest stress that a material is capable of sustaining without any deviation from proportionality of stress-to-strain (Hooke's law) expressed in force per unit area.

4. Significance and Use

4.1 This test method provides information regarding the behavior of cellular materials under compressive loads. Test data is obtained, and from a complete load-deformation curve it is possible to compute the compressive stress at any load (such as compressive stress at proportional-limit load or compressive strength at maximum load) and to compute the effective modulus of elasticity.

4.2 Compression tests provide a standard method of obtaining data for research and development, quality control, acceptance or rejection under specifications, and special purposes. The tests cannot be considered significant for engineering design in applications differing widely from the load - time scale of the standard test. Such applications require additional tests such as impact, creep, and fatigue.

4.3 Before proceeding with this test method, reference shall be made to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters, or a combination thereof, covered in the materials specification shall take precedence over those mentioned in this test method. If there are no material specifications, then the default conditions apply.

5. Apparatus

5.1 *Testing Machine*—A testing instrument that includes both a stationary and movable member and includes a drive system for imparting to the movable member (crosshead), a uniform, controlled velocity with respect to the stationary member (base). The testing machine shall also include the following:

5.1.1 *Load Measurement System*—A load measurement system capable of accurately recording the compressive load imparted to the test specimen. The system shall be indicate the load with an accuracy of ±1 % of the measured value or better. The accuracy of the load measurement system shall be verified in accordance with Practices E 4.

5.2 *Compression Platens*—Two flat plates, one attached to the stationary base of the testing instrument and the other attached to the moving crosshead to deliver the load to the test specimen. These plates shall be larger than the specimen loading surface to ensure that the specimen loading is uniform. It is recommended that one platen incorporate a spherical seating mechanism to compensate for non-parallelism in the specimen's loading surfaces or non-parallelism in the base and crosshead of the testing instrument.

5.3 *Displacement Measurement System*—A displacement measurement system capable of accurately recording the compressive deformation of the test specimen during testing to an accuracy of ±1 % of the measured value or better. This measurement is made through use of the test machine crosshead drive system or using a direct measurement of compression platen displacement.

5.3.1 *Direct Compression Platen Displacement*—This system shall employ a deflectometer that directly reads the distant between the upper and lower compression platens. The accuracy of the displacement measurement transducer shall be verified in accordance with Practices E 83 and shall be classified as a Class C or better.

5.3.2 *Test Machine Crosshead Drive System*—This system shall employ the position output from the crosshead drive system as a indicator of compression platen displacement. This method is only appropriate when it is demonstrated that the effects of drive system compliance result in displacement errors of less than 1 % of the measurement or if appropriate compliance correction methods are employed to reduce the measurement error to less than 1 %.

5.3.2.1 *Determining Drive System Compliance*—Testing instrument drive systems always exhibit a certain level of compliance that is characterized by a variance between the reported crosshead displacement and the displacement actually imparted to the specimen. This variance is a function of load frame stiffness, drive system wind-up, load cell compliance and fixture compliance. This compliance can be measured then, if determined to be significant and empirically subtracted from test data to improve test accuracy. The procedure to determine compliance follows:

(1) Configure the test system to match the actual test configuration.

(2) Position the two compression platens very close to each other simulating a zero thickness specimen in place.

(3) Start the crosshead moving at 12.5 mm [0.5 in.]/min in the compression direction recording crosshead displacement and the corresponding load values.

(4) Increase load to a point exceeding the highest load expected during specimen testing. Stop the crosshead and return to the pre-test location.

(5) The recorded load-deflection curve, starting when the compression platens contact one another, is defined as test system compliance

5.3.2.2 *Performing Compliance Correction*—Using the load-deflection curve created in 5.3.2.1, measure the system compliance at each given load value. On each specimen test curve at each given load value, subtract the system compliance from each recorded displacement value. This will be the new load-deflection curve for use in calculations starting in Section 9.

5.4 *Micrometer Dial Gage*, caliper, or steel rule, suitable for measuring dimensions of the specimens to ±1 % of the measured values.

6. Test Specimen

6.1 The test specimen shall be square or circular in cross section with a minimum of 25.8 cm^2 [4 $in.^2$] and maximum of 232 cm^2 [36 $in.^2$] in area. The minimum height shall be 25.4 mm [1 in.] and the maximum height shall be no greater than the width or diameter of the specimen. Care should be taken so that the loaded ends of the specimen are parallel to each other and perpendicular to the sides.

NOTE 2—Cellular plastics are not ideal materials, and the compressive modulus may appear significantly different, depending on the test conditions, particularly the test thickness. All data that are to be compared should be obtained using common test conditions.

6.2 All surfaces of the specimen shall be free from large visible flaws or imperfections.

6.3 If the material is suspected to be anisotropic, the direction of the compressive loading must be specified relative to the suspected direction of anisotropy.

6.4 A minimum of five specimens shall be tested for each sample. Specimens that fail at some obvious flaw should be discarded and retests made, unless such flaws constitute a variable the effect of which it is desired to study.

7. Conditioning

7.1 *Conditioning*—Condition the test specimens at 23 ± 2°C [73.4 ± 3.6°F] and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, unless otherwise specified in the contract or relevant material specification. In cases of disagreement, the tolerances shall be ±1°C [±1.8°F] and ±2 % relative humidity.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C [73.4 ± 3.6°F] and 50 ± 5 % relative humidity, unless otherwise specified. In cases of disagreement, the tolerances shall be ±1°C [±1.8°F] and ±2 % relative humidity.

8. Procedure

8.1 Measure the dimensions of the specimen to a precision of ±1 % of the measurement as follows:

8.1.1 Thicknesses up to and including 25.4 mm [1 in.] shall be measured using a dial-type gage having a foot with minimum area of 6.45 cm^2[1 $in.^2$]. Hold the pressure of the dial foot to 0.17 ± 0.03 kPa [0.025 ± 0.005 psi].

8.1.2 Measure dimensions over 25.4 mm [1 in.] with a dial gage, a sliding-caliper gage, or a steel scale. When a sliding-caliper gage is employed, the proper setting shall be that point at which the measuring faces of the gage contact the surfaces of the specimen without compressing them.

8.1.3 Record each dimension as an average of three measurements.

8.2 Place the specimen between the compression platens ensuring that the specimen center-line is aligned with the center-line of the compression platens and the load will be distributed as uniformly as possible over the entire loading surface of the specimen. It will expedite the testing process if, when the specimen is in place, the upper platen is positioned close to, but not touching, the specimen.

8.2.1 If following 5.3.2.1, attach the deflectometer or compression extensometer to the compression platens.

8.3 Start the crosshead moving in the direction to compress the specimen with the rate of crosshead displacement of 2.5 ± 0.25 mm [0.1 ± 0.01 in.]/min for each 25.4 mm [1 in.] of specimen thickness.

8.4 Record compression platen displacement and the corresponding load data. This recorded curve will be used directly if following 5.3.2.1 or could be modified following 5.3.2.2.

8.5 Continue until a yield point is reached or until the specimen has been compressed approximately 13 % of its original thickness, whichever occurs first.

8.5.1 When specified, a deformation other than 10 % may be used as the point at which stress shall be calculated. In such a case, compress the specimen approximately 3 % more than the deformation specified. Substitute the specified deformation wherever "10 % deformation" is cited in Sections 9 and 10.

9. Calculation

9.1 Using a straightedge or through the use of computer software, carefully extend to the zero load line the steepest straight portion of the load-deflection curve examining only the lower portion of the load-deflection curve. This establishes the "zero deformation" or "zero strain" point (Point O in Fig. 1a and Fig. 1b). Measure all distances for deformation or strain calculations from this point.

9.2 Measure from Point O along the zero-load line a distance representing 10 % specimen deformation. At that point (Point M in Fig. 1a and Fig. 1b), draw a vertical line intersecting the load-deflection or load-strain curve at Point P.

9.2.1 If there is no yield point before Point P (as in Fig. 1b), read the load at Point P.

9.2.2 If there is a yield point before Point P (as Point L in Fig. 1), read the load and measure the percent core deformation or strain (Distance O-R) at the yield point.

9.2.3 Calculate the compressive strength by dividing the load (9.2.1 or 9.2.2) by the initial horizontal cross-sectional area of the specimen.

9.3 If compressive modulus is requested, choose any convenient point (such as Point S in Fig. 1b) along the steepest straight line portion of the load-deflection or load-strain curve. Read the load and measure the deformation or strain (Distance O-T) at that point.

9.3.1 Calculate the apparent modulus as follows:

$$E_c = WH/AD \quad (1)$$

where:

E_c = modulus of elasticity in compression, Pa [psi],
W = load, N [lbf],
H = initial specimen height, m [in.],
A = initial horizontal cross-sectional area, m² [in.²], and
D = deformation, m [in.].

9.3.2 Calculate the estimated standard deviation as follows:

$$s = \sqrt{(\Sigma x^2 - n\bar{X}^2)/(n-1)} \quad (2)$$

where:

s = estimated standard deviation,
x = value of a single observation,
n = number of observations, and
$\bar{X}$ = arithmetic mean of the set of observations.

10. Report

10.1 Report the following information:

10.1.1 Complete identification of the material tested, including type, source, code numbers, form, principal dimensions, previous history, and so forth.

10.1.2 Number of specimens tested if different from that specified in 6.4.

10.1.3 Conditioning procedure used if different from that specified in Section 7.

10.1.4 Atmospheric conditions in test room if different from those specified in Section 7.

TABLE 1 Precision Data

Materials	Average, psi	S_r[A]	S_R[B]	r[C]	R[D]
A	13.6307	1.1491	1.6078	3.2174	4.5019
B	31.3183	1.0944	1.1213	3.0642	3.1398
C	10.3981	0.9796	1.0764	2.7430	3.0141

[A] S_r= within-laboratory standard deviation for the indicated material. It is obtained by pooling the within-laboratory standard deviations of the test results from all of the participating laboratories.
[B] S_R= between-laboratories reproducibility, expressed as standard deviation.
[C] r = within-laboratory critical interval between two test results = 2.8 × S_r.
[D] R = between-laboratories critical interval between two test results = 2.8 × S_R.

10.1.5 Values for each specimen, plus averages and standard deviations, of modulus (if requested) and compressive strength.

10.1.6 Deformation at maximum load to two significant figures.

10.1.7 Date of test.

11. Precision

11.1 Table 1 is based on a round robin[4] conducted in 1998 in accordance with Practice E 691, involving three materials tested by seven laboratories. For each material, all of the samples were prepared at one source, but the individual specimens were prepared at the laboratories that tested them. Each test result was the average of seven individual determinations. Each laboratory obtained six test results for each material. Precision, characterized by repeatability (S_r and r) and reproducibility (S_R and R) has been determined as shown in Table 1. **Warning**—The explanation of r and R are only intended to present a meaningful way of considering the approximate precision of this test method. The data in Table 1 should not be applied to acceptance or rejection of materials, as these data apply only to the materials tested in the round robin and are unlikely to be rigorously representative of other lots, formulations, conditions, materials, or laboratories. Users of this test method should apply the principles outlined in Practice E 691 to generate data specific to their materials and laboratory.

NOTE 3—The precision data presented in Table 1 was obtained using the test conditions defined in this test method. If a material specification defines other test conditions, this precision data shall not be assumed to apply.

12. Keywords

12.1 cellular plastics; compressive modulus; compressive strength

[4] Supporting data are available from ASTM Headquarters. Request RR:D20-1201.

SUMMARY OF CHANGES

This section identifies the location of selected changes to this test method. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this test method. This section may also include descriptions of the changes or reasons for the changes, or both.

D 1621 – 04a:

(*1*) Revised the definition of *deflectometer*.

D 1621 – 04:

(*1*) Test method was revised throughout.

D 1621 – 00:

(*1*) Section 3, Terminology —Changed definitions to meet the one sentence requirement.

(*2*) Added 4.3.

(*3*) Revised 7.1.

(*4*) Added 9.3.2.

(*5*) Added precision statement, Section 11, including Cautionary note 4 and Note 3.

(*2*) Included the Summary of Changes section.

REPORT OF COMPARATIVE EVALUATION

OF DRAINAGE MEDIA HYDRAULIC PROPERTIES

Performance Comparison of Flowtech™ Synthetic Aggregate to Conventional Sand and Gravel Drainage Media

---

Prepared For:

Mr. Harry Bussey, III
ICC TECHNOLOGIES, INC.
240 Boundary Road
Marlboro, New Jersey 07746

~

Prepared By:

UNIFOUR ENGINEERING & TESTING LABORATORIES, P.C.
PO Box 2067
Hickory, North Carolina 28603
Unifour Job Number: 3091

~

June 15, 2007

NORTH CAROLINA PROFESSIONAL SEAL 19385 ENGINEER BOBBY L. BARNES

Bobby L. Barnes, PE
Principal Engineer
Registered, NC 19385

TABLE OF CONTENTS

Performance Comparison of Flowtech™ Synthetic Aggregate to Conventional Sand and Gravel Drainage Media

1.0 INTRODUCTION

UNIFOUR ENGINEERING & TESTING LABORATORIES, P.C. (Unifour) has completed a comparative evaluation of the Flowtech™ synthetic aggregate to conventional sand and gravel drainage media with respect to hydraulic conductivity under saturated, steady state flow characteristics. The purpose of the testing was to evaluate performance of the synthetic aggregate materials under low head flow rate measurement. Testing procedures were established by Unifour's engineers to represent drainage conditions typical to shallow subgrade drainage applications.

Hydraulic conductivity (usually denoted "K" in formulas and frequently interchanged with "*permeability*") is a measure of the capability that a material has to transmit water. Porosity, permeability, specific yield, and specific retention are all components of hydraulic conductivity. Several other factors, such as internal friction and the various paths water can and does take through a material also have an affect on hydraulic conductivity. Hydraulic head (typically denoted "h" in hydrology formulas) is the name given to the driving force that moves water through a material. The hydraulic head combines fluid pressure and gradient, which can be thought of as the driving forces applied by or to the water to pass through a material. In 1856, Henry Darcy studied the movement of water through porous material and determined an equation that best described water flow through a porous material in a single direction of flow. This equation has come to be known as Darcy's Law.

Darcy's law is a simple proportional relationship between the instantaneous discharge rate through a porous medium, the viscosity of the fluid and the pressure drop over a given distance.

$$Q = \frac{-KA}{\mu}\frac{(P_b - P_a)}{L}$$

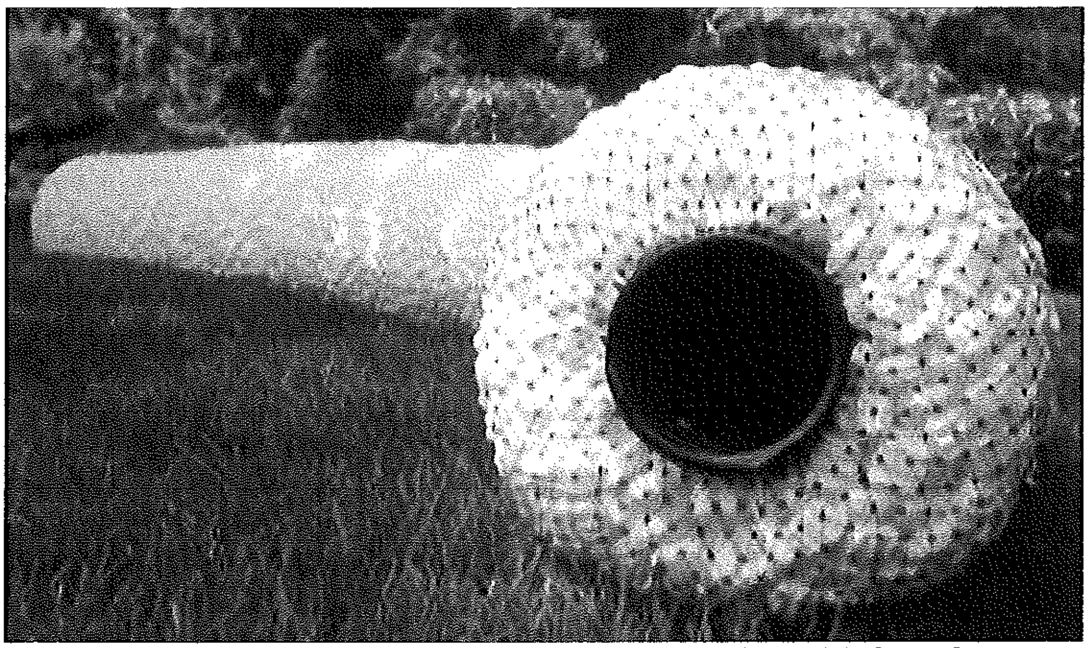
The total discharge, Q (units of volume per time, e.g., cm^3/s) is equal to the product of the permeability (κ) for a particular medium, the cross-sectional area (A) to flow, and the pressure drop ($P_b - P_a$), all divided by the viscosity μ, and the length L over which the pressure drop occurs. The negative sign is applied in the full equation because fluids flows from high pressure to low pressure, and flow needs to be represented positive or negative to be representative of occurring in the same direction as the drop in pressure. Simplifying this equation using water as the fluid with a viscosity of 1, and rearranging it so that a direct representation of permeability can be made, the equation becomes usable for assessing the hydraulic conductivity of the medium for a specific measured flow rate.

$$K = \frac{Q\,L}{(P_b - P_a)\,A} = \frac{Q\,L}{H\,A}$$

It is this basis of assessing hydraulic conductivity that has been applied to all of the testing performed by Unifour. All opinions and conclusions presented within this report are based on facts, conditions, and observations existing at the time of the testing and on the products as delivered to us. No other representation is intended or implied.

2.0 PRODUCT BACKGROUND

The Flowtech™ drainage product is ICC Technologies, Inc.'s manufactured subsurface drainage solution to the construction industry's need for alternatives to conventional pipe and gravel drainage systems. The design of the Flowtech system utilizes lightweight, man-made polystyrene aggregate surrounding a perforated 4-inch corrugated plastic drain pipe and encased in either a polyethylene netting or non-woven geosynthetic filter fabric to produce a composite drainage product deliverable in 10-foot sections. Product sections can be coupled together for continuous open pipe flow using standard 4-inch plastic pipe internal compression couplings. Flowtech is manufactured currently in both 10-inch and 12-inch outside effective diameter configurations, but it has been reported to us that additional sizes may soon be available.



Product Representation Photo used by Permission from ICC Flowtech

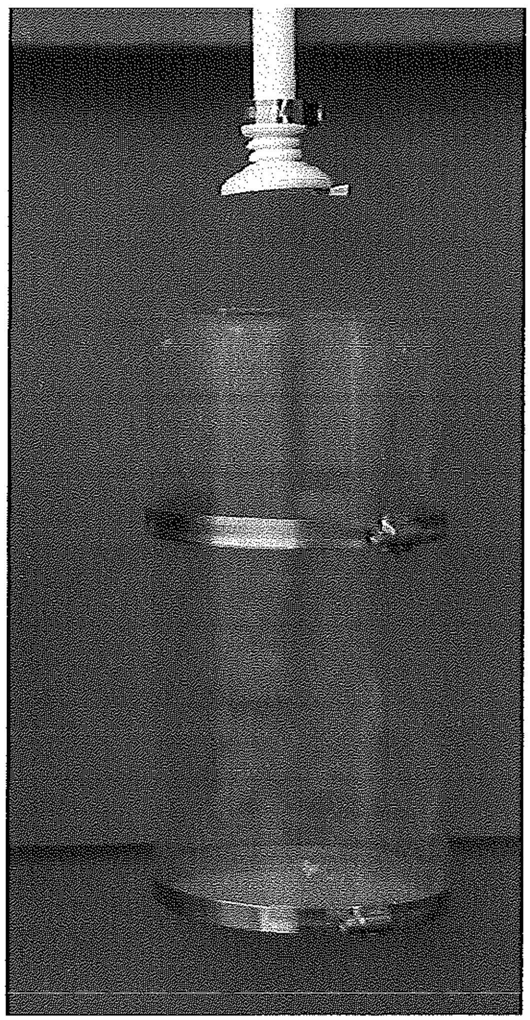
Details on the specific product components used in the manufacturing of Flowtech were supplied to Unifour and have been included as attachments to this report.

3.0 PRODUCT TESTING PROCEDURES

Unifour received delivery of several samples of bulk synthetic aggregate in loose form that is typically used in the manufacture of Flowtech drainage products in both netting encased and fabric encased configurations. As mentioned in the introduction of this report, the purpose of the testing was by the request of ICC Technologies, Inc. was to evaluate performance of the synthetic aggregate materials under low head flow rate measurement. The intention of the test was to determine if the Flowtech™ products synthetic aggregate materials were comparable to conventional sand and gravel drainage materials.

The objective of testing was to produce an environment in which the quantifiable flow of water under low head could be obtained for equal volumes and cross-sectional areas without producing a situation. The test setup consisted of a stationary panel onto which was mounted a series of acrylic glass cylinders open at each end. Each of the cylinders were identical in average interior diameter at 5.75 inches, having equivalent open end areas of 0.180 square feet. Each cylinder was 12 inches in length. Wire mesh screen was affixed across the bottom opening of each cylinder and reinforced with 3/8 inch woven wire grid to reinforce the mesh. Mounted directly above the open end of each cylinder was ¾-inch PVC plumbing to provide supply water via connection to a pressurized water supply source at Unifour's laboratory. Flow through the PVC plumbing could be regulated by way of an in-line ball valve, with water transferred into the chamber through a conventional shower spray head to prevent a concentrated flow from creating an agitating or turbulent condition that could introduce trapped air into the samples.

Prior to introducing any test materials into the chambers, the threshold flow rate of the test system was verified. This step was performed to be sure that the chamber itself did not provide any restrictions to flow that could influence the conductivity measurements of the samples themselves. The water supply was turned on to its maximum flow rate, and it was observed that the chamber allowed the full flow to pass through freely without building up any water level inside the chamber. Also, this step allowed Unifour personnel an opportunity to verify the repeatability of our flow measurement methods. Flow measurements were made by collecting all flow out of the bottom of the chamber for a recorded amount of time into an empty container of known tare weight. The container with the collected water was weighed to determine the net weight of water that passed through the chamber and into the collector over the recorded time interval. This process was repeated several times for each chamber to verify repeatability of the sampling methods and to determine if any significant fluctuations existed in the supply flow. Maximum flow rates ranged between 113.7 and 114.6 pounds per minute and averaged at 114.2 pounds per minute (13.69 gallons per minute).



Empty Sample Chamber mounted and showing screened bottom opening and water supply plumbing

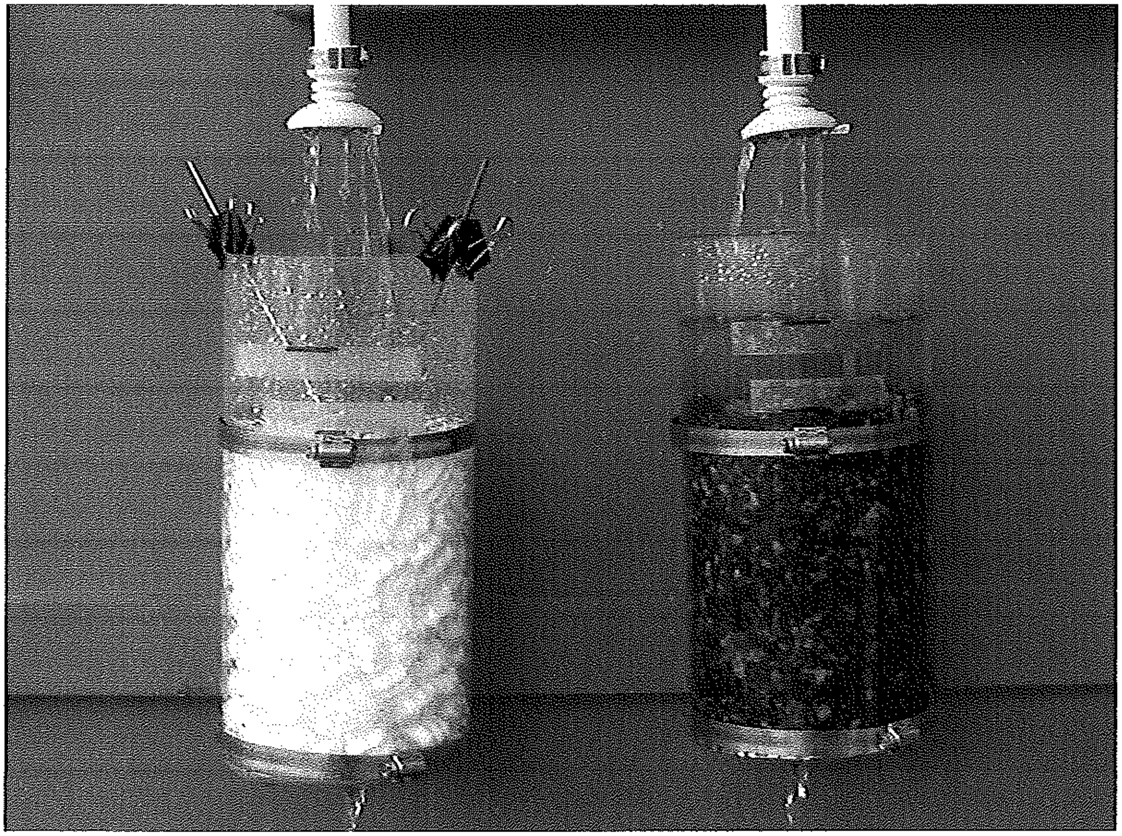
Testing of the various drainage materials were arranged in the following configurations:

- ASTM C33 screened and washed concrete masonry sand, 8 inches of sand only in the chamber.
- NCDOT Grade #57 washed gravel aggregate, 8 inches of gravel only in chamber.
- Flowtech™ Synthetic Aggregate, 8 inches of aggregate only in the chamber*

(**Note: because the synthetic aggregate is lightweight with a specific gravity less than water, the samples had to be confined in the chambers using 3/8 inch woven wire mesh anchored into the chamber at the top of the sample during testing)*

After each sample configuration was placed into the test chamber, the first step of the test was to develop a steady state flow condition within each chamber using a marked line at a fixed height above the bottom of the chamber at which to maintain a constant water level inside the chamber. Supply water flow was gradually increased until a water level began to stage up inside the chamber. Once the water level inside the chamber had reached the reference mark and completely submerged the test sample configuration, the supply flow was reduced. Over a period of 15 minutes, the supply valve was repeatedly adjusted as necessary to establish a flow rate that would maintain the water level inside the chamber at the constant marked reference line.

Once steady state flow was established and the 15 minute hold time had elapsed, our personnel began a sequence of measuring flow rates by the method described previously. Each sample configuration was tested six times, with the data recorded for averaging and determination of standard deviation.



Chambers configured during testing with Synthetic Aggregate side-by-side to Gravel Aggregate

4.0 TEST RESULTS & DISCUSSION

The following presents Unifour's observations and discussion of the test data recorded for comparative evaluation of the Flowtech™ synthetic aggregate to conventional sand and gravel drainage media with respect to hydraulic conductivity under saturated, steady state flow characteristics.

Q (flow in lbs./min)								
Device	**Trial #1**	**Trial #2**	**Trial #3**	**Trial #4**	**Trial #5**	**Trial #6**	**Mean**	**Std. Dev.**
Flowtech Agg. (8")	>100	>100	>100	>100	>100	>100	>100	N/A
57 Stone Gravel (8")	3.66	3.88	3.62	3.74	3.80	3.70	3.733	0.095
Sand (8")	2.72	2.72	2.72	2.78	2.74	2.68	2.727	0.033

Q (flow in gal./min)								
Device	**Trial #1**	**Trial #2**	**Trial #3**	**Trial #4**	**Trial #5**	**Trial #6**	**Mean**	**Std. Dev.**
Flowtech Agg. (8")	>12	>12	>12	>12	>12	>12	>12	N/A
57 Stone Gravel (8")	0.44	0.46	0.43	0.45	0.46	0.44	0.447	0.011
Sand (8")	0.33	0.33	0.33	0.33	0.33	0.32	0.327	0.004

HYDRAULIC CONDUCTIVITY COMPARISON					
Device	**Q Flow (GPM avg.)**	**L Length of sample (ft)**	**H Head of Water (ft.)**	**A, Surface Area of Chamber (ft^2)**	**K_{sat} Saturated Conductivity (gpm/ft^2)**
Flowtech Agg. (8")	12	0.67	0.833	0.18	53.62
57 Stone Gravel (8")	0.45	0.67	0.83	0.18	2.00
Sand (8")	0.33	0.67	0.83	0.18	1.46

CONCLUSIONS

Based on the observations and data collected during testing for synthetic aggregate used in the Flowtech™ 12-inch drainage, Unifour developed the following conclusions:

- The Flowtech™ Synthetic Aggregate is hydraulically superior with respect to having the highest flow rates under low head conditions and providing the least hydraulic resistance in comparison to both typical graded gravel aggregate and graded sands as tested.
- Data from this testing suggests that the Flowtech™ Synthetic Aggregate used in a drainage application should be expected to provide a capacity for flow of water at a hydraulic conductivity rate at least 20 times the rate achievable by conventional gravel and/or sand drainage installations under equivalent head and cross-sectional area.

BLACKWELL ENGINEERING, PLC

566 E. MARKET ST. • HARRISONBURG, VIRGINIA 22801 • (540) 432-9555 • FAX (540) 434-7604

June 12, 2006

Mr. Carl Perry and Mr. Mike Stidham
President and Vice President, E-Z Set Company
P.O. Box 176
Haymarket, VA 20168

Subject: E-Z Set's Flow Tech H-10 Load Test

Dear Mr. Perry and Mr. Stidham:

The effort to determine the "Performance of Flow Tech Drainage Products Under an H-10 Load Rating" has shown conclusively that extreme soil loading has no affect on the corrugated pipe used in Flow Tech's drainage product.

After a load rating of H-10 (16,000-pounds per axle) was applied, the corrugated pipe in the product showed no visual signs of physical damage of deformation. The diameter of the corrugated pipe remained the same for the FTS 1236 product configurations after the H-10 load was applied.

Results of this test indicate there were no visual signs of physical damage to the internal coupler used to connect the bundles. Additionally, the polystyrene aggregate and physical properties of the product appeared unchanged after loading.

It is the professional opinion of Blackwell Engineering that Flow Tech drainage product can withstand a load of 16,000-pounds per axle with 12-inches of compacted soil cover without any physical damage and can be given a load rating of H-10.

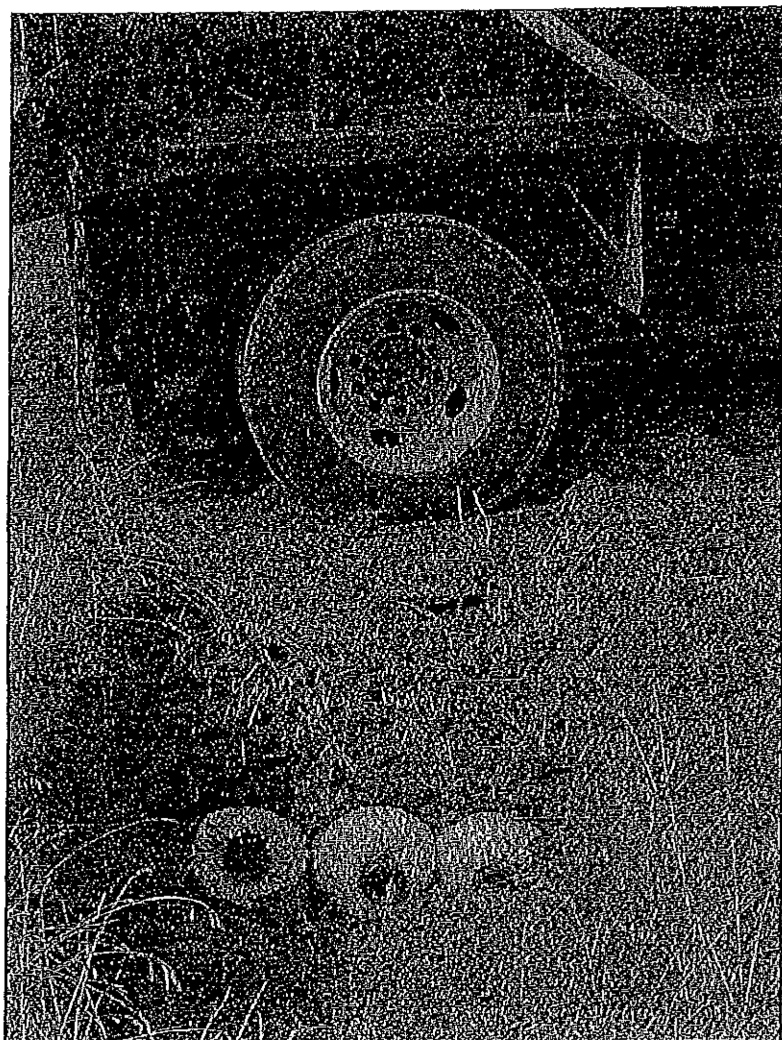
Sincerely,

Richard L. Blackwell III, P.E.
VA P.E. # 024322

6-12-06

CIVIL ENGINEERS SPECIALIZING IN LAND DEVELOPMENT, ENVIRONMENTAL NEEDS AND CONSTRUCTION MANAGEMENT SERVING COMMERCIAL, INDUSTRIAL AND MUNICIPAL CLIENTS

Evaluation of Flow Tech Brand Drainage Products
Under an AASHTO H-10 Load Rating



8 May 2006

COMMONWEALTH OF VIRGINIA
RICHARD B. BLACKWELL III
NO. 24322
6-12-06
PROFESSIONAL ENGINEER

NORTH CAROLINA
PROFESSIONAL
SEAL
031270
ENGINEER
RICHARD B. BLACKWELL III

INDEX

Evaluation of Flow Tech Brand Drainage Products Under An AASHTO H-10 Load Rating

May 8, 2006

Abstract

A Flow Tech brand drainage product made of hardened expanded polystyrene, 4 inch corrugated pipe, and polyethylene netting was evaluated under the American Association of State Highway and Traffic Officials (AASHTO) load rating of H-10 (16,000 lbs/axle). The product configuration tested was the FTS 1236.

Twenty trench feet of FTS 1236 were installed in a 36 inch wide trench under 12 inches of compacted soil cover. For this configuration a single axle dump truck with a total weight of 33080 lbs made two passes over the center of the trench with a wheel lined up directly over the center connection of the bundles. On both passes, the dump truck was parked with the load bearing rear axle on the trench. After the load was removed, the bundles were excavated for visual inspection and evaluation.

A pass/fail performance rating of the corrugated pipe in the center of the product was rendered and a visual inspection and a visual inspection of the polystyrene aggregate, and the netting did not crush, collapse, or fail and a pass rating was given.

Background

Flow Tech drainage products are designed to be lightweight yet very durable. The expanded polystyrene aggregate is engineered to resist extreme loading. In some states, regulatory agencies require that alternative drainage products have a load rating of H-10. For states requiring this H-10 load rating, the following test was conducted to evaluate the performance of the Flow Tech brand drainage systems under a load of 16,000 lbs per axle or as defined by AASHTO, H-10.

FTS 1236

The product configuration used in the test is denoted as FTS 1236 (Figure 1). The FTS 1236 drain field system consists of three 12 inch diameter bundles placed in a 36 inch wide trench. The bundles contain aggregate pieces made of expanded polystyrene and a 4 inch corrugated polyethylene pipe. Both the aggregate and the 4 inch pipe are packed tightly inside a 12 inch diameter tube of polyethylene netting.

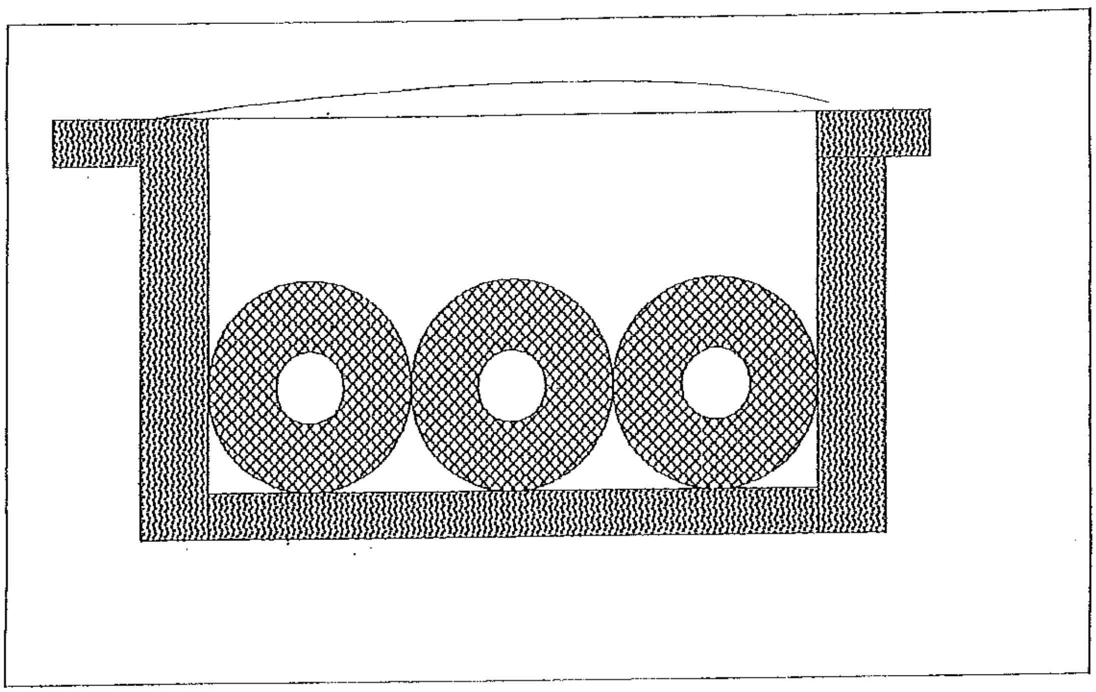


Figure 1

Methods and Materials

The test consisted of twenty linear feet of FTS 1236 (six 10 foot bundles of 12 inch diameter product). The configuration was placed in a 20'L x 36"W x 24"D trench, and the two center bundles were connected using a 4 inch internal coupling (Figure 2). The 4 inch corrugated pipe in the product was inspected and diameter measurements were taken for comparison after the load was applied.

Initial Pipe Measurement (FTS 1236)

Corrugated Pipe Diameter (Prior to Applied Load) = 3.950 inch ID

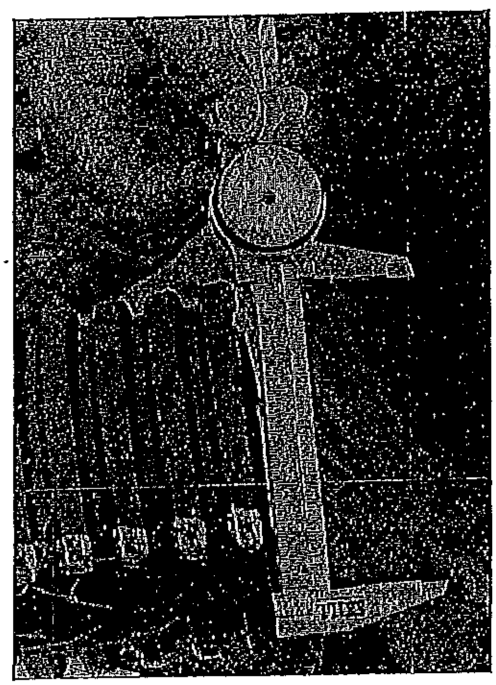


Figure 2

Load

An H-10 load was applied to the test bundles using a two axle dump truck. The dump truck was loaded to a total weight of 33, 080 lbs. The total weight of the truck was dispersed over the two axles with 16,540 per axle on both front and rear axles. The axle weight was verified using a scale at the Luck Stone Corporation (Appendix A). The dump truck made two passes over the test bundles in a manner so that the front and load bearing wheels of the dump truck passed over the buried test bundles. One wheel passed directly over the center where the test bundles were connected using the 4 inch internal coupler and the other wheel line simply passed over the product (Figure 3). On both passes, the dump truck was parked with one of the load bearing axles on the trench. After the load had been applied, the test bundles were excavated for visual inspection and measurement.

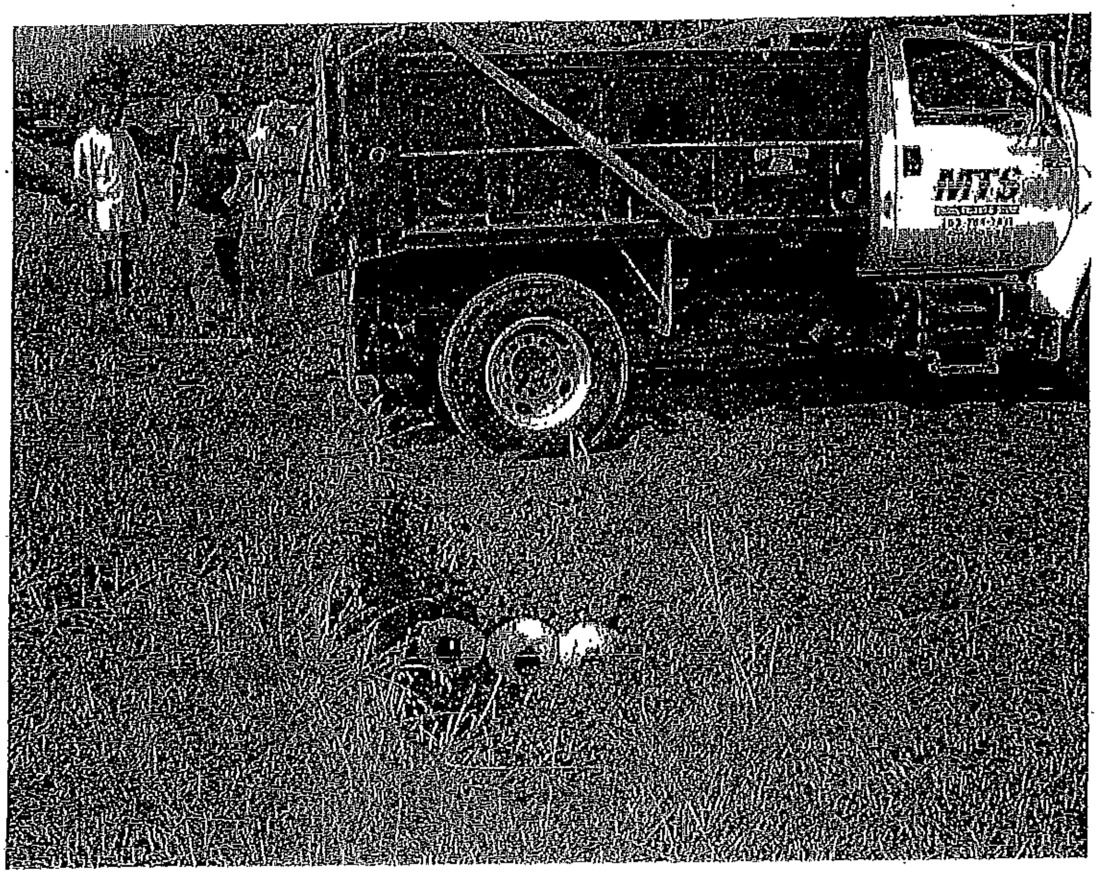


Figure 3

Results and Discussion

A pass/fail performance rating was given based on weather the 4 inch diameter corrugated pipe in the FTS 1236 sustained the load without any collapsing, fracturing, or breaking. Inspection of the corrugated pipe from the excavated bundles showed no visual signs of collapsing or breaking (Figure 4). The diameter of the pipe was measured in the same location where the axial load was applied. Table 1 below shows that the diameter of the corrugated pipe was equal to the measurement taken prior to the applied load. There were also no visual signs of damage to the 4 inch internal coupling that connects the bundles. The polystyrene aggregate and the polyethylene netting demonstrated no evidence of damage that would indicate compaction under load. Since no physical damage occurred to the pipe or product, a pass performance rating was given.

Table 1

Corrugated Pipe	Before Applied Load	After Applied Load	Test Result
FTS 1236 Inside Diameter	3.950 Inches	3.950 Inches	Pass

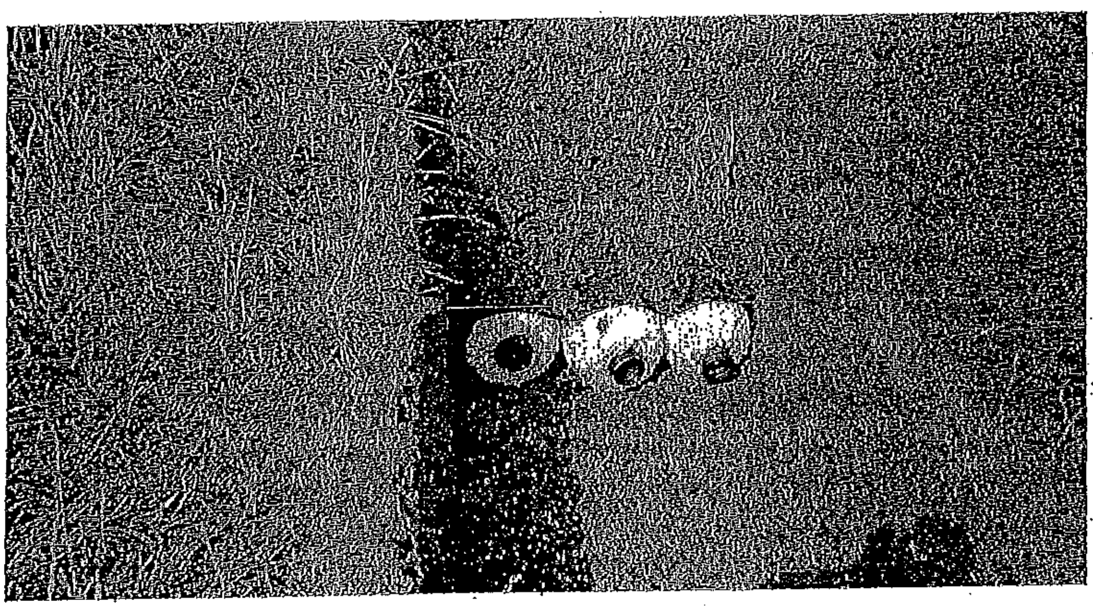


Figure 4

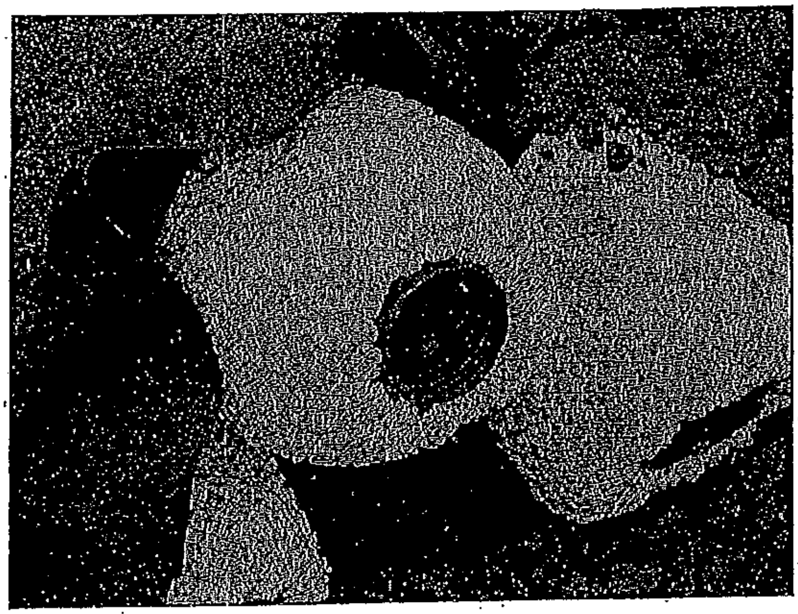


Figure 5

Conclusions

The effort to determine the "Performance of the Flow Tech Drainage Products Under An H-10 Load Rating" has shown conclusively that extreme top loading, whether live (moment) loads or static (dead) loads has little or no effect on the Flow Tech Drainage Product.

After a load rating of H-10 (16,000 lbs. per axle) was rolled onto the trench holding the Flow Tech Product and covered with 12 inches of compacted soil, simulating moment, the truck was then parked on the trench, making sure that one wheel load was directly on top of the connection joint. The pipe showed no visual signs of physical damage or deformation. The diameter of the corrugated pipe remained the same after the load was applied.

Results of this test indicate there were no visual signs of damage to the internal coupler used to connect the bundles and that the bundles were still connected. Additionally, the polystyrene aggregate and the netting holding the polystyrene aggregate appeared unchanged after loading. This lack of deformation would indicate that there was no significant loss of void space.

It is the professional opinion of Blackwell Engineering that Flow Tech Drainage Product can withstand a load of 16,000 lbs. per axle with a 12-inch cover of compacted soil without physical damage.