JOHN ELIAS BALDACCI
GOVERNOR

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
11 STATE HOUSE STATION
OFFICE: 161 CAPITOL STREET
AUGUSTA, MAINE
04333-0011

November 18, 2003

Septi-chip LLC
Attn.: Daniel J. Williams
P. O. Box 991
Norwalk, CT 06856

Subject: Proprietary Device Product Registration, Septi-chip tire chips

Dear Mr. Williams:

The Division of Health Engineering has completed a review of the product 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.

Product Description

The Septi-chip tire chips consist of chipped used automobile tires. The Septi-chip tire chips are intended for use with conventional onsite sewage disposal areas. Chip sizes range from 3/8 inch to four inches diameter, based upon a nominal chip size of two inches. Installation of Septi-chip tire chips includes covering the disposal area with a layer of nonwoven filter fabric, specifically, Cultec 410 filter fabric or equivalent.

Claim

According to the information you provided, and information otherwise available to the Division, the flowing States have approved tire chips for use as aggregate in onsite sewage disposal systems: Florida (ref.: interoffice memorandum dated 4/24/00), Virginia Department of Health (ref.: GMP #91 and Appendix I, dated 8/21/97), North Carolina Department of Environment, On-site Wastewater Section (ref.: Experimental System Approval #EWWS-96-2 dated 10/01/96 and Innovative Wastewater System Approval #IWWS-2002-03), among others.

Leachate from tire chips is a notable concern of many regulatory agencies. Several reports were included in the application documenting testing of tire chip leachate for contaminants (ref.: Amoozegar and Roberge, North Carolina State University; Sengupta and Miller, University of Massachusetts 10/99 and 10/00; among others). Based upon these reports, and independent literature and internet research by the Division, tire chip leachate does not exceed primary drinking water standards for metals and compounds such as benzene and petroleum distillates. However, it can exceed secondary drinking water standards for color and iron.

Beneficial use of tire chips is allowed by the Maine Department of Environmental Protection through Permit By Rule. Ref.: Maine Solid Waste Management Rules, Chapter 418, Section 4.

Determination

On the basis of the information submitted and information otherwise available to the Division, the Division has determined that the tire chips are acceptable for use in the State of Maine as a substitute for disposal area stone, with the following conditions:

PHONE: (207) 287-5338 TTY: 207-287-2070 FAX: (207) 287-4172

1. Septi-chip tire chips are allowed for use in Maine as a substitute for stone aggregate, with the same square foot rating as stone aggregate, provided that the product must be specifically included in a design (HHE-200 Form).

2. Septi-chip tire chips shall not be installed in lieu of stone in a design that specifies stone, absent a revision of the design by a licensed site evaluator.

3. The Septi-chip tire chips shall be clean, and free of fines, dust, ashes, soil, or clay.

4. The Septi-chip tire chips in a disposal area shall be covered with at least one layer of Cultec 410 nonwoven filter fabric or equivalent, when installed as part of an onsite sewage disposal system.

5. In the event that the product fails to perform as claimed by the applicant, use of Septi-chip tire chips as a substitute for disposal area stone in Maine, including all installations approved pursuant to Section 1801.7 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

6. This letter supersedes the letter dated October 15, 2003 by this office.

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 tire chips. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar 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

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

Fax

To: John Black, LPI **From:** Jim Jacobson, EHS IV

Fax: 287-3165 **Phone:** 287-5695

Date: 7/11/06 **Pages:** (including cover sheet) 3

Re: Septi-Chip

☐ **Urgent** ☒ **As Requested** ☐ **For Your Information** ☐ **Please Reply**

John- SSWD rules don't address stockpiling, maybe DEP does (1-800-452-1942). Also, Septi-Chip is the only tire chips product currently approved in Maine for septic systems.

Jim

Jacobsen, James

From: Daniel Williams [dwilliams@tireworx.com]
Sent: Thursday, January 22, 2004 2:54 PM
To: dawn.r.gallagher@maine.gov; randy.l.mcmullin@maine.gov; eric.p.hamlin@maine.gov; liz_baker@collins.senate.gov; john.mclaughlin@mail.house.gov; brian.mahany@legislative.maine.gov; jlmartin@maine.edu; koffman@acadia.net; james.jacobsen@maine.gov; russell.martin@maine.gov
Subject: re: Review by D.E.P. et al

Ok Randy I guess this does not apply to us do to the nature of our site selling recycled beneficially used material/products, not to accomplish post-closure care of the solid waste facility as described in your regs.Also as you are well aware that 26 States have approved the use of tire chips in septic systems as it has been approved in the State of Maine.But I guess that is not Sufficient enough to Convince You.I will continue to pursue a legislative approach for the rules to be changed, Please contact your rules commitee, that we will be seeking immediate advice to this situation and request their assistance in this matter, also we will be requesting the assistance of The Congress of the United States to oversight in this matter with regards to the Commerce Clause in the Constitutional drafts as pertaining to Interstate commerce and Protectionistic Regulations imposed by Local and or State powers. Randy also if you could be so kind as to possibly supply me with information of how many and more specifically who has been charged Surety with regards to Recycled Products in the State of Maine, Including but not limited to Mulch, Both natural and Rubberized also how it is being enforced currently.I look forward to meeting with you Tomorrow.

Thanks
Daniel Williams
Septi-Chip
Original Message:
>From: "McMullin, Randy L" <Randy.L.McMullin@Maine.gov>
>To: "'dwilliams+AEA-tireworx.com'" <dwilliams@tireworx.com>
>Subject: RE: Review by D.E.P. et al
>Date: Thu, 22 Jan 2004 14:20:10 -0500

>OK I have an answer as to the requirements for financial ability Chapter
>400.4.B. covers it.
>
>
>B. Financial Ability
>
>(1) Standards.
>
>(a) The applicant must have the financial ability to design, construct,
>operate, maintain, close and (if applicable) accomplish post-closure care of
>the solid waste facility in a manner consistent with all applicable
>requirements.
>
>(b) The applicant for a solid waste disposal facility shall provide
>adequate financial assurance for closure, post-closure care, and for
>corrective action for known releases in compliance with the financial
>assurance requirements of section 11.
>
>
>(2) Submissions. The application must include evidence that
>affirmatively demonstrates that the applicant has the financial ability to
>undertake the proposed project, including the following information, when
>appropriate:
>
>(a) Accurate cost estimates for the design, construction, operation,
>maintenance, closure and (if applicable) post-closure care of the solid
>waste facility.
>
>(b) Evidence that funds are or will be available to design, construct,
>operate, maintain, close and (if applicable) accomplish post-closure care of

>the solid waste facility, or to contract for the same, including the
>following:
>
>(i) when a financial institution is the funding source, the application
>must include:
>
>a. a letter from a financial institution, governmental agency, or other
>funding agency indicating a commitment to provide a specified and sufficient
>amount of funds and the uses for which the funds may be utilized; or
>
>b. in cases where funding is required but there can be no commitment of
>money until approvals are received, a letter of "intent to fund" from the
>appropriate funding institution. Evidence of financing must be provided
>prior to project construction.
>
>(ii) when self-financing is a funding source for the solid waste
>facility, the application must include:
>
>a. the most recent corporate annual report indicating availability of
>sufficient funds to finance the proposed project, through self-financing,
>together with explanatory material interpreting the report;
>
>b. evidence that funds are available and have been set aside for
>completion of the proposed project; or
>
>c. if the applicant is a governmental entity, evidence that the entity
>has the bonding or other capacity to finance the proposed project.
>
>Here is the link so that you can read them in context.
>
>http://www.maine.gov/sos/cec/rcn/apa/06/096/096c400.doc
>
>
>You will need to convince us that should this project not work, you will
>have adequate resources to remove the materials for disposal at a licensed
>facility. Example, Waste Management gives you a letter saying they will
>accept up to 100 tons at $40 a ton, and you have a financial surety bond
>saying you have those funds available.
>
>You would be allowed to stockpile up to 100 tons at your storage site.
>
>I will see you tomorrow. I leave at 4 PM.
>
>Randy McMullin
>
>
>
>Randy McMullin
>Environmental Specialist
>Maine Department of Environmental Protection
>312 Canco Road
>Portland, Maine 04103
>(207) 822-6343
>Fax (207) 822-6303
>
>
>
>-----Original Message-----
>From: Daniel Williams [mailto:dwilliams@tireworx.com]
>Sent: Thursday, January 22, 2004 1:51 PM
>To: Randy.L.McMullin@Maine.gov
>Subject: RE: Review by D.E.P. et al
>
>
>Ok then ,weather permiting of course, I should be arriving in Portland for
>2:30 pm will this work for you, maybe later? Let me know , You can catch me
>on the cell-203-610-0722 or email me back

>
>Daniel Williams
>Project Leader
>Septi-Chip
>
>Original Message:
>>From: "McMullin, Randy L" <Randy.L.McMullin@Maine.gov>
>>To: "'dwilliams+AEA-tireworx.com'" <dwilliams@tireworx.com>
>>Subject: RE: Review by D.E.P. et al
>>Date: Thu, 22 Jan 2004 11:32:14 -0500
>
>>Sure come on up. I will try to have an answer for you. Morning or early
>>afternoon would be best.
>>
>>Here is how you get here.
>>
>>http://www.state.me.us/dep/smro.htm
>>
>>Randy
>>
>>-----Original Message-----
>>From: Daniel Williams [mailto:dwilliams@tireworx.com]
>>Sent: Thursday, January 22, 2004 11:15 AM
>>To: Randy.L.McMullin@Maine.gov
>>Subject: RE: Review by D.E.P. et al
>>
>>
>>I'm coming to Maine tomorrow where can we meet to discuss all the
>necessary
>>requirement, paperwork, as well as what I also need to clearly understand
>is
>>what will be required with Surety issues can you please ask your Boss for
>>the Answer if you do not have it, thanks
>>
>>Original Message:
>>>From: "McMullin, Randy L" <Randy.L.McMullin@Maine.gov>
>>>To: "'dwilliams+AEA-tireworx.com'" <dwilliams@tireworx.com>, "McMullin,
>>Randy L" <Randy.L.McMullin@Maine.gov>
>>>Subject: RE: Review by D.E.P. et al
>>>Date: Thu, 22 Jan 2004 11:01:59 -0500
>>
>>>Well when you decide to do something, I will be here.
>>>
>>>Send your application(s) to my attention at this address and I will get
>>them
>>>in the license processing system.
>>>
>>>Randy McMullin
>>>
>>>Randy McMullin
>>>Environmental Specialist
>>>Maine Department of Environmental Protection
>>>312 Canco Road
>>>Portland, Maine 04103
>>>(207) 822-6343
>>>Fax (207) 822-6303
>>>
>>>
>>>-----Original Message-----
>>>From: Daniel Williams [mailto:dwilliams@tireworx.com]
>>>Sent: Thursday, January 22, 2004 10:49 AM
>>>To: Randy.L.McMullin@Maine.gov
>>>Cc: Jim.S.Glasgow@maine.gov; Paula.M.Clark@maine.gov;
>>>Eric.P.Hamlin@maine.gov
>>>Subject: RE: Review by D.E.P. et al
>>>
>>>

>>>Randy as per our telephone conversation, We will apply for a storage
>permit
>>>by rule as discussed in previous conversations, but are entertaining the
>>>idea of this license that you are presenting as an alternative to our
>>>operational concerns. the questions that will be raised by our associates
>>>are all the legalities towards the sites of operation including but not
>>>limited to surety requirements if any, as you and I discussed on the phone
>>>Surety requirements will escalate the pricing of our product to a price
>>that
>>>will not make it a viable market for our product as well is only required
>>>for whole tire processing facilities, let me know so we can start the
>paper
>>>work. thank you
>>>
>>>Daniel Williams
>>>Project Leader
>>>
>>>Septi-Chip
>>>203-610-0722
>>>
>>>Original Message:
>>>>From: "McMullin, Randy L" <Randy.L.McMullin@Maine.gov>
>>>>To: "'dwilliams+AEA-tireworx.com'" <dwilliams@tireworx.com>
>>>>Subject: RE: Review by D.E.P. et al
>>>>Date: Thu, 15 Jan 2004 16:22:35 -0500
>>>
>>>>Dan,
>>>>
>>>>I have another thought which might very well remove your concerns about
>>the
>>>>storage of tire chips are user location and about the transportation of
>>>tire
>>>>chips by contractors.
>>>>
>>>>The Maine Solid Waste Management Regulations Chapter 400.1 has the
>>>following
>>>>definition of "tires"
>>>>
>>>>Ttt. Tires. "Tires" means a solid waste consisting of any used, scrap,
>or
>>>>otherwise discarded rubberized vehicle tires, including whole tires as
>>well
>>>>as the products derived from the processing of whole tires, including but
>>>>not limited to shredded or chipped tires or crumb rubber.
>>>>
>>>>Therefore, according to the Chapter 411 Rules, anyone hauling any amount
>>of
>>>>"tires" (see definition above) is required to hold a Non Hazardous Waste
>>>>Transporter's License. No exceptions.
>>>>
>>>>Although the use of tire chips in septic systems is "exempt" from
>>>Department
>>>>licensing under Chapter 418.2.P which states,
>>>>
>>>>"P. The beneficial use of tire chips used in subsurface waste water
>>>>disposal units as permitted in the Maine Subsurface Waste Water Disposal
>>>>Rules."
>>>>
>>>>You could still apply for a Department license for the Beneficial Use of
>>>>Tire Chips in Septic Systems, which could cover the your storage and
>>>>transportation, and storage and transportation of tire chips by the users
>>>of
>>>>the material in one Department license.
>>>>
>>>>Go to our rules, applications, fees, and processing timelines (links
>>>>attached). This application would be filed under Chapter 418 Section 7.
>>>>The code would be WL "an ongoing beneficial use other than utilization

>>>>without a Risk Assessment".
>>>>
>>>>http://www.maine.gov/sos/cec/rcn/apa/06/096/096c418.doc
>>>>
>>>>http://www.state.me.us/dep/rwm/application_forms/418ap.doc
>>>>
>>>>http://www.state.me.us/dep/rwm/solidwaste/pdf/fees2004.pdf
>>>>
>>>>http://www.state.me.us/dep/times.pdf
>>>>
>>>>This process is designed to address your concerns as well as the
>>>>Department's responsibilities for proper licensing of your operation. It
>>>is
>>>>possible that a local license for your storage facility may be required
>by
>>>>the local town. I would check with them also.
>>>>
>>>>If you decide to apply for a Department license, let me know and I will
>go
>>>>over with you the information the Department would require so that you
>>>don't
>>>>spend a lot of time putting together a lot of information that would not
>>>>benefit either you as the applicant or the Department as the application
>>>>gets processed.
>>>>
>>>>If you have any question, call me or e-mail me. E-mail usually works
>>best.
>>>>
>>>>
>>>>Randy McMullin
>>>>Environmental Specialist
>>>>Maine Department of Environmental Protection
>>>>312 Canco Road
>>>>Portland, Maine 04103
>>>>(207) 822-6343
>>>>Fax (207) 822-6303
>>>>
>>>>
>>>>
>>>>
>>>>-----Original Message-----
>>>>From: Daniel Williams [mailto:dwilliams@tireworx.com]
>>>>Sent: Wednesday, January 14, 2004 12:46 PM
>>>>To: dawn.r.gallagher@maine.gov; randy.l.mcmullin@maine.gov;
>>>>eric.p.hamlin@maine.gov; liz_baker@collins.senate.gov;
>>>>john.mclaughlin@mail.house.gov; brian.mahany@legislative.maine.gov;
>>>>jlmartin@maine.edu; koffman@acadia.net; james.jacobsen@maine.gov;
>>>>russell.martin@maine.gov
>>>>Subject: Review by D.E.P. et al
>>>>
>>>>
>>>>To State of Maine Department Of Environmental Protection, ET al,
>>>>
>>>>As in previous telephone discussions I am looking for assistance in
>>>>providing clear answers to our Products future in your State and
>>inevitably
>>>>the future of beneficial use of tires within the State of Maine. Recently
>>>my
>>>>company has proposed the use of Septi-Chip 2" Nominal Chip for use in
>>>Septic
>>>>and Nitrification Applications and by which has just Recently been
>>approved
>>>>within the State of Maine. What we propose to have reviewed is that under
>>>>the current Regulations all tires are considered a waste stream
>regardless
>>>>of it's value and all transportation of tires is required to have a
>>>>registered transporter of waste by the D.O.T. and the D.E.P. The problem

>>>>that has arisen under the law is the fact that our product cannot be
>>>>purchased and transported by the contractor to the Onsite Septic
>>>>installation destination and stored on the site unless the contractor has
>>>>registered their vehicles as a waste transporter and with regards to the
>>>>storage of our product a storage permit must be obtained. This is quite
>>>>confusing seeing that under Maine regulations tires that are used for sub
>>>>surface water applications are exempt from D.E.P. rules and regulations.
>>So
>>>>here we are with a product that is approved to used in the State of Maine
>>>>but anyone wishing to purchase our product must spend money in order to
>>>>transport the material and spend money and wait for approval at least 20
>>>>days in order to store the material onsite at the point of installation
>>>>which effectively destroys the possibility of creating a marketplace for
>>>>beneficially used recycled products within the State.
>>>>
>>>>What I suggest and implore you to consider is a compromise that may be
>>able
>>>>to offer a solution to the recent bureaucratic developments:
>>>>
>>>>1.) All locations that sell and store Septi-Chip 2" inch nominal tire
>chip
>>>>specifically with bin storage dimensions of up to 100'L x 100'W x 12'H
>>>shall
>>>>be required to have a permit to store by rule, with an exception to the
>>>rule
>>>>only to apply at the site of installation and or repair, i.e. the home
>>>>owners septic installation site, leach field etc.
>>>>
>>>>2.) ALL locations that sell and Store Septi-chip 2" inch Nominal tire
>chip
>>>>are to keep records of all transactions for a period not to exceed 1 year
>>>>and to have these records available onsite for review by a dully
>appointed
>>>>D.E.P. officer upon request.
>>>>
>>>>3.) All locations that sell and Store Septi-Chip 2" inch Nominal Tire
>Chip
>>>>are required to provide a copy of a bill of lading to the contractor at
>>the
>>>>time of sale which is to include information of transaction such as point
>>>of
>>>>sale location, amount of Septi-Chip product sold, (i.e. cubic yards etc)
>>as
>>>>well as specification of product use, Contractor who has purchased
>>product,
>>>>and address of onsite Septic install and or repair.
>>>>
>>>>4.) All locations that sell and store Septi-Chip 2" inch Nominal Tire
>Chip
>>>>are required to provide to purchaser and to keep record of driver
>manifest
>>>>which shall include name of driver, driver signature, registered
>>>transporter
>>>>number, plate number of vehicle (i.e. truck or tractor and trailer) With
>>>the
>>>>exception to this rule to only apply to contractors that are transporting
>>>>their material directly to the onsite wastewater install or repair, it
>>will
>>>>however be required to fill out the manifest but the transporters vehicle
>>>>shall not need to be registered with the D.E.P. and the D.O.T. as a
>>>licensed
>>>>transporter of waste. Manifest may be combined with bill of lading
>>document
>>>>to provide less paperwork for all parties involved in transaction.
>>>>
>>>>I hope that this can be reviewed and accepted so that we may continue our
>>>>pursuit to promote the use of our product within Maine and to provide the

>>>>Rest of the New England States, a template in which to follow in cases
>>like
>>>>this, regarding beneficial use of tires.
>>>>
>>>>Sincerely
>>>>
>>>>Daniel Williams
>>>>
>>>>Project Leader
>>>>Septi-Chip LLC.
>>>>203-610-0722 cell
>>>>
>>>>
>>>>
>>>
>>>
>>>
>>
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>>
>
>
>

Original Message:
>From: "Daniel Williams" <dwilliams@tireworx.com>
>To: <dawn.r.gallagher@maine.gov>,<randy.l.mcmullin@maine.gov>,<eric.p.hamlin@maine.gov>,
<liz_baker@collins.senate.gov>,<john.mclaughlin@mail.house.gov>,
<brian.mahany@legislative.maine.gov>,<jlmartin@maine.edu>,<koffman@acadia.net>,
<james.jacobsen@maine.gov>,<russell.martin@maine.gov>
>Subject: Review by D.E.P. et al
>Date: Wed, 14 Jan 2004 10:46:17 -0700

>To State of Maine Department Of Environmental Protection, ET al,
>
>As in previous telephone discussions I am looking for assistance in providing clear answers to our Products future in your State and inevitably the future of beneficial use of tires within the State of Maine. Recently my company has proposed the use of Septi-Chip 2" Nominal Chip for use in Septic and Nitrification Applications and by which has just Recently been approved within the State of Maine. What we propose to have reviewed is that under the current Regulations all tires are considered a waste stream regardless of it's value and all transportation of tires is required to have a registered transporter of waste by the D.O.T. and the D.E.P. The problem that has arisen under the law is the fact that our product cannot be purchased and transported by the contractor to the Onsite Septic installation destination and stored on the site unless the contractor has registered their vehicles as a waste transporter and with regards to the storage of our product a storage permit must be obtained. This is quite confusing seeing that under Maine regulations tires that are used for sub surface water applications are exempt from D.E.P. rules and regulations. So here we are with a product that is approved to used in the State of Maine but anyone wishing to purchase our product must spend money in order to transport the material and spend money and wait for approval at least 20 days in order to store the material onsite at the point of installation which effectively destroys the possibility of creating a marketplace for beneficially used recycled products within the State.
>
>What I suggest and implore you to consider is a compromise that may be able to offer a solution to the recent bureaucratic developments:
>
>1.) All locations that sell and store Septi-Chip 2" inch nominal tire chip specifically with bin storage dimensions of up to 100'L x 100'W x 12'H shall be required to have a permit to store by rule, with an exception to the rule only to apply at the site of installation and or repair, i.e. the home owners septic installation site, leach field etc.
>
>2.) ALL locations that sell and Store Septi-chip 2" inch Nominal tire chip are to keep records of all transactions for a period not to exceed 1 year and to have these records available onsite for review by a dully appointed D.E.P. officer upon request.
>

>3.) All locations that sell and Store Septi-Chip 2" inch Nominal Tire Chip are required to provide a copy of a bill of lading to the contractor at the time of sale which is to include information of transaction such as point of sale location, amount of Septi-Chip product sold, (i.e. cubic yards etc) as well as specification of product use, Contractor who has purchased product, and address of onsite Septic install and or repair.
>
>4.) All locations that sell and store Septi-Chip 2" inch Nominal Tire Chip are required to provide to purchaser and to keep record of driver manifest which shall include name of driver, driver signature, registered transporter number, plate number of vehicle (i.e. truck or tractor and trailer) With the exception to this rule to only apply to contractors that are transporting their material directly to the onsite wastewater install or repair, it will however be required to fill out the manifest but the transporters vehicle shall not need to be registered with the D.E.P. and the D.O.T. as a licensed transporter of waste. Manifest may be combined with bill of lading document to provide less paperwork for all parties involved in transaction.
>
>I hope that this can be reviewed and accepted so that we may continue our pursuit to promote the use of our product within Maine and to provide the Rest of the New England States, a template in which to follow in cases like this, regarding beneficial use of tires.
>
>Sincerely
>
>Daniel Williams
>
>Project Leader
>Septi-Chip LLC.
>203-610-0722 cell
>
>
>

Jacobsen, James

From: McMullin, Randy L
Sent: Thursday, January 08, 2004 5:09 PM
To: Jacobsen, James
Cc: Glasgow, Jim S; Hamlin, Eric P
Subject: Use of Tire Chips in Septic Systems

Jim,

Thank you for sending me a copy of the DHS approval for Septi-Chip LLC dated November 18, 2003.

I would just like to clarify a point in you approval letter which states, "Beneficial Use of tire chips is allowed by the Maine Department of Environmental Protection through Permit by Rule" and references the Maine Solid Waste Management Regulations, Chapter 418, Section 4.

A more appropriate reference within the Regulations would be:

Chapter 418

2. Beneficial Use Activities Not Subject To The Requirements Of This Chapter. The following beneficial use activities are exempt from regulation under this chapter:

P. The beneficial use of tire chips used in subsurface waste water disposal units as permitted in the Maine Subsurface Waste Water Disposal Rules.

also the storage of the stockpiled beneficial use materials is regulated under Chapter 402 of the Regulations as stated in Chapter 4181.B which states,

"**Storage of Secondary material.** Beneficial use activities that include storing secondary materials for greater than 90 days are also subject to Chapter 402 of these rules."

Thank you and if you have any questions or if I can be of any assistance, please feel free to call me at (207) 822-6343.

Randy McMullin
BRWM
ME DEP

John Elias Baldacci
Governor

State of Maine
Department of Human Services
Division of Health Engineering
11 State House Station
Augusta, Maine
04333-0011

DATE 4/13/04 TIME AM/PM

TO: Dan Williams

FROM: Jim Jacobsen, ES IV

PAGES INCLUDING THIS COVER SHEET: 3

MESSAGE:

copy of final Septi Chip approval

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
11 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0011

JOHN ELIAS BALDACCI
GOVERNOR

DATE TIME AM/PM

TO: John Wilson

FROM: Jim Jacobsen

#PAGES INCLUDING THIS COVER SHEET: 2

MESSAGE:

Septi-Chip approval
attached
-corrected pg. 2

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
11 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0011

JOHN ELIAS BALDACCI
GOVERNOR

DATE 11/17/03 TIME AM/PM

TO: Dan Williams

FROM: Jim Jacobsen, EIT IV

#PAGES INCLUDING THIS COVER SHEET: ~~2~~ 2

MESSAGE:

fire chip proprietary approval, sorry for delay, been on phone 100% since yo

*correct fax, John Wilson

698-5181

fax 203-334-7451

Dan Williams

NOTICE: This fax r ...ie individual or entity identified above. It m ...nd / or confidential under both state and f ...ent or an agent of the recipient, you are not ...discloser of this communication is str ...nsmittal in error, please immediately notify _____ and return the original transmissior ...gusta, ME 04333-0011, without making a co ...tial information is greatly appreciated.

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
11 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0011

JOHN ELIAS BALDACCI
GOVERNOR

October 15, 2003

Septi-chip LLC
Attn.: Daniel J. Williams
P. O. Box 991
Norwalk, CT 06856

Subject: Product Registration, Septi-chip tire chips

Dear Mr. Williams:

The Division of Health Engineering has completed a review of the product 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.

Product Description

The Septi-chip tire chips consist of chipped used automobile tires. The Septi-chip tire chips are intended for use with conventional onsite sewage disposal areas.

Claim

According to the information you provided, and information otherwise available to the Division, the flowing States have approved tire chips for use as aggregate in onsite sewage disposal systems: Florida (ref.: interoffice memorandum dated 4/24/00), Virginia Department of Health (ref.: GMP #91 and Appendix I, dated 8/21/97), North Carolina Department of Environment, On-site Wastewater Section (ref.: Experimental System Approval #EWWS-96-2 dated 10/01/96 and Innovative Wastewater System Approval #IWWS-2002-03), among others.

Leachate from tire chips is a notable concern of many regulatory agencies. Several reports were included in the application documenting testing of tire chip leachate for contaminants (ref.: Amoozegar and Roberge, North Carolina State University; Sengupta and Miller, University of Massachusetts 10/99 and 10/00; among others). Based upon these reports, and independent literature and internet research by the Division, tire chip leachate does not exceed primary drinking water standards for metals and compounds such as benzene and petroleum distillates. However, it can exceed secondary drinking water standards for color and iron.

Beneficial use of tire chips is allowed by the Maine Department of Environmental Protection through Permit By Rule. Ref.: Maine Solid Waste Management Rules, Chapter 418, Section 4.

Determination

On the basis of the information submitted and information otherwise available to the Division, the Division has determined that the tire chips are acceptable for use in the State of Maine as a substitute for disposal area stone, with the following conditions:

1. The tire chips shall be clean, and free of fines, dust, ashes, soil, or clay.

2. The tire chips shall be uniform in size in any individual installation, no smaller than ¾ inch and no larger than 2 ½ inches in size. No more than 2 (two) percent by weight of tire chips in any installation shall be nonconforming to the uniform size specified in any individual design.

3. In the event that the product fails to perform as claimed by the applicant, use of tire chips as a substitute for disposal area stone in Maine, including all installations approved pursuant to Section 1801.7 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

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 tire chips. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar 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

Jacobsen, James

From: Jacobsen, James
Sent: Thursday, October 16, 2003 8:14 AM
To: 'dwilliams@tireworx.com'
Cc: Martin, Russell; Gauvreau, Paul
Subject: RE: tire chips approved

septi-chip tie chip aggregate....

Daniel,

I understand your manufacturing specs, but at present I see no compelling argument in favor of waiving the long-standing aggregate standards in the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules. Give me a few dates, and I'll set up your meeting.

As to this office exercising allegedly inappropriate powers, well, I'm not a lawyer. I suggest you have a lawyer write a letter to us with your specific concerns, and we'll run it past the Attorney General's office.

James Jacobsen, ES IV

enc: approval document

-----Original Message-----
From: Daniel Williams [mailto:dwilliams@tireworx.com]
Sent: Wednesday, October 15, 2003 7:36 PM
To: james.jacobsen@state.me.us
Subject: fw: tire chips approved

Jim,

We thank you very much for your diligence and pursuit of this beneficial use application, however there is a misunderstanding with the specifications, a 2" nominal chip is classified as being no less than 1/4" to 4 inches in any one direction, your current spec, restricts the possibility of use of proven sized material by different machines and processors.The sieve analysis we provided to your agency was based on 2" nominal and not 2 1/2" minus. I ask that a meeting be held to discuss this and any other concerns towards this beneficial use. so that we can address changes that are needed to be made.Also in section 3 of your letter it puts protectionistic policies and stipulations that under the constitutional commerce clause would only be granted and empowered by the powers of congress and not state or local government with regards to interstate and foreign trade. In light of the foregoing we wish to resolve these issues A.S.A.P. seeing that time is of the essence with this matter.
I look forward to meeting with you.

Sincerely,

Daniel J. Williams
Project Leader
Septi-Chip llc

203-610-0723
Original message attached.

Jacobsen, James

From: Jacobsen, James
Sent: Tuesday, October 21, 2003 8:36 AM
To: 'dwilliams@tireworx.com'
Subject: meeting

Jacobsen, James.vcf

Daniel,

Russell Martin, my supervisor, has the 28th and 29th of October available, and November 4. If one of these days works for you, let me know. I'd suggest we get together around 2pm so you don't have to get up at the crack of dawn.

James Jacobsen, ES IV

Jacobsen, James

From: Daniel Williams [dwilliams@tireworx.com]
Sent: Wednesday, October 15, 2003 7:36 PM
To: james.jacobsen@state.me.us
Subject: fw: tire chips approved

Original message.eml

Jim,

We thank you very much for your diligence and pursuit of this beneficial use application, however there is a misunderstanding with the specifications, a 2" nominal chip is classified as being no less than 1/4" to 4 inches in any one direction, your current spec, restricts the possibility of use of proven sized material by different machines and processors.The sieve analysis we provided to your agency was based on 2" nominal and not 2 1/2" minus. I ask that a meeting be held to discuss this and any other concerns towards this beneficial use. so that we can address changes that are needed to be made.Also in section 3 of your letter it puts protectionistic policies and stipulations that under the constitutional commerce clause would only be granted and empowered by the powers of congress and not state or local government with regards to interstate and foreign trade. In light of the foregoing we wish to resolve these issues A.S.A.P. seeing that time is of the essence with this matter.
I look forward to meeting with you.

Sincerely,

Daniel J. Williams
Project Leader
Septi-Chip llc

203-610-0723
Original message attached.

Jacobsen, James

From: Jacobsen, James
Sent: Wednesday, October 15, 2003 11:15 AM
To: 'dwilliams@tireworx.com'
Subject: tire chips approved

Hi Daniel,

I've attached the finalized version of Maine's approval for tire chips as aggregate in onsite wastewater disposal systems. The signed copy on letter head follows via snail mail.

Jim Jacobsen, ES IV

septi-chip tle chip aggregate....

Jacobsen, James

From: Jacobsen, James
Sent: Tuesday, October 14, 2003 9:25 AM
To: 'dwilliams@tireworx.com'
Subject: review status

Daniel,

I'll be wrapping up my preliminary review today and forwarding the write up to my supervisor for review.

Jim Jacobsen, ES IV

Fax Cover Sheet

To: James Jacobsen
From: Danny Williams

Fax
Phone: 207-287-4172

Pages: 3 including cover

SEPTI-CHIP

Product Specifications:

1.) Shall be clean and free (98% or better by weight of any soil particles (Fines) either adhering to the chips or floating loose within the chips:

2.) Shall be nominally two (2) inches in size and may range from Three eights (3/8) of an inch to a maximum of (4) inches in any one direction (95% or better by weight); and Exposed wire may protrude no more than one-half (1/2) inch from (90% of the chips)

3.)Shall be graded or sized in accordance with size numbers 2, 3, and 24 of ASTM D-448 (Standard sizes of coarse aggregate)

4.) Shall be covered with a single and continuous layer of non-woven Filter fabric extending across the top of the tire chip aggregate before backfilling. The fabric shall have a unit weight of at least 3.0oz. /yd2 (ASTM D-5261), a permittivity of at least 1.0 sec-1 (per ASTM D-4491), a trapezoid tear strength of at least 35 lbs. (per ASTM D-4533), And have a mesh size equal to U.S. Sieve No 70 (A.O.S.)(ASTM D-4751). It is recommended to use Cultec 410 filter fabric or equivalent.

SEPTI-CHIP

State Recommendations:

1.) It is recommended that all tire chips not used in the Onsite sewage treatment and disposal system shall be removed from the site by the installer or contractor for the onsite wastewater system.

2.) It is recommended that no soil shall contaminate the tire chips during installation.

3.) It is recommended that any tire processor wishing to provide tire chip aggregate for use in onsite sewage treatment and disposal systems in the State shall receive written approval from the local health department. Tire processors must provide proof that they can continuously produce a tire chip coarse aggregate in conformance with the product specifications of this approval; tire processors shall submit a representative sample of tire chips to the local health department; The processor shall have samples analyzed by a third party laboratory qualified to conduct particle size analysis for compliance with the product specifications; Documentation of tire processors product meeting the product specifications, shall be submitted as requested within reason, at least yearly, to the local health department. Noncompliance with this approval may subject a tire processor to suspension or revocation of their approval until it is determined that said processor falls into compliance with the local health department.

4.) It is recommended that tire chip aggregate for subsurface sewage effluent absorption systems shipped from approved tire processors shall be accompanied by a freight bill of lading labeled as drain field aggregate. The bill-of-lading shall certify that the material meets the specifications for drain field use. Contractors purchasing tire chip coarse aggregate shall retain a copy of the freight bill-of-lading as documentation of the tire chip aggregate size and quality. A copy of the bill of lading shall be provided to the local health department prior to issuance of the operation permit and shall be retained with the operation permit filed with the local health department.

Jacobsen, James

From: Daniel Williams [dwilliams@tireworx.com]
Sent: Tuesday, October 28, 2003 3:35 PM
To: john.mclaughlin@mail.house.gov; brian.mahany@legislature.maine.gov; jlmartin@maine.edu; koffman@acadia.net; james.jacobsen@maine.gov; russell.martin@maine.gov
Subject: 2" nominal tire chips as an alternative to aggregate stone approval

To whom this may concern:
Oct. 28th 2003

My name is Daniel J. Williams and I along with my company Septi-Chip LLC am currently undergoing the task of presenting our product within the New England States as well as New York along with corresponding scientific data from various states currently using similar products. We have put in an application to the State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. to gain acceptance and regulatory approval of 2"nominal tire chips to be used as an alternative to aggregate stone in septic and nitrification applications, a beneficial use of tires that has been approved and used in as many as 24 States of our Great Nation. Tires as you may well know have been a burdensome problem within our nation due to illegal stockpiles, which pose the health risks of providing breeding grounds for vectored species, which have been known to carry diseases such as Asian Tiger Mosquito's carrying West Nile and Eastern Equine Encephalitis. Tires are also known to pose the risk of ground water and air contamination when tires piles have caught on fire, as been seen in some of the States. While we are very happy to receive notice that an approval has been issued in the State of Maine due to our application, we are having a problem with the sizing criteria imposed on us by the State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. Our application and our scientific data was for 2" nominal tire chip which is defined as a tire chip which is ½" in size to 4"inches in any one direction and not 2 or 2 ½"minus tire chip which is defined as being less than 2 ½ inch in any one directions. When we addressed our concern to the State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. that this stipulation would greatly affect our pricing structure to be competitive to aggregate stone and the fact that our manufacturing machines used to make our 2"inch nominal tire chips can not make a 2" minus without considerable costs of processing and new machinery which can exceed $800,000.00 per machine. The response from the State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. Was for us to present a "Good Reason For Why The State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. Should change it's 30 some odd year regulations that pertain to Aggregate Stone" which requires stone to not be more than 2 ½" minus to be used in septic and nitrification applications. Now although 2" nominal tire chips have been proven to be equal to and or better than aggregate stone in septic and nitrification applications. It should be noted that we are talking about a different product altogether and should viewed with the specifications that have been proven and used with respect to our products ability to perform as an alternative to aggregate stone in septic and nitrification applications. In light of the foregoing we feel that we now need to ask for help from the Senate and Congress in our endeavors in the State of Maine. We have included correspondence which we shall forward in email format that we have exchanged with the State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. We are having a meeting tomorrow the 29th at 2:00pm with Jim Jacobsen and his supervisor from State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg.located at Capitol Avenue to meet and try to convince the State of Maine Department of Human Services Bureau of Health Division of Health Engineering Wastewater & Plumbing Prg. and we request that you attend or to send you're input as to our proposed beneficial use of tires in septic and nitrification applications. I wish to express my thanks in advance upon my company and myself to all who help in our fight to preserve our natural resources and to contribute to the reduction of unnecessary disposal of solid waste to our landfills.

Sincerely

Daniel J. Williams

Project Leader
Septi-Chip LLC.
203-610-0722 203-610-0723 203-384-8968 email dwilliams@tireworx.com

Maine Department of Human Services
Bureau of Health
Division of Health Engineering
Wastewater & 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: Septi-chip LLC.
Contact Person: Daniel J. Williams
Address: P.O. Box 991
Town/City: Norwalk State/Province: CT Zip Code: 06856
Country: U.S.A.
Telephone: 203-334-7421 e-mail: dwilliams@Tireworx.Com

Product

Product Name: Septi-chip
Model: #1 2" Nominal Chip

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 [✓] 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). 2" Nominal

~~See attached~~ — use of tire chips as a substitute for aggregate stone in septic and nitrification applications – See Attached

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

~~See attached~~ equal to and or better in performance than aggregate stone – See Attached

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, Daniel J. LeMieux, am the [ ] 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.

Daniel J. LeMieux — 8/8/03

[ ] Signature of Applicant
[ ] Signature of Agent for Applicant — Date

N.C. Approval of Tire Chips for Use in Septic System Drainlines Will Yield Multiple Environmental Benefits

By Christine Miller
Division of Environmental Health

Before 2002 came to an end, the Division of Environmental Health issued its first-ever generic approval of an innovative septic system treatment component: recycled tire chips. The chips, when manufactured to strict specifications, may be used as a substitute for rock aggregate (gravel) in any septic system drainage beds or trenches using gravel. This use of tire chips could have far-reaching environmental benefits in addition to those associated with wastewater treatment. The chips, which are currently used for this purpose in seventeen states nationwide, including all but one of the southeastern states, may provide economic benefits as well.

First there are the environmental benefits they're intended to provide: wastewater treatment. "Intensive scientific review has documented that for this use, tire chips give treatment to wastewater constituents equal to that of rock aggregate," said Dr. Barbara Hartley Grimes, Non-Point Source Pollution Coordinator for the Division of Environmental Health. "In terms of physical characteristics, wastewater treatment, performance, and durability, it works, and it works as well as gravel. Numerous studies have documented no leachate problems affecting primary drinking water standards," she said.

The tire chips may yield some unexpected wastewater treatment benefits, as well. During the research phase, Grimes and Steve Steinbeck of the OSWW and Dr. Aziz Amoozegar, the NCSU soil scientist who performed the initial experimental systems research in North Carolina, visited South Carolina, which has used tire chips for over fifteen years. There they unearthed some eight-year-old tire chip drainlines and gravel drainlines, and were impressed with what they discovered in those containing tire chips. Macrobiotic organisms such as protozoa, nematodes and oliochaetes were all present, which came as a surprise to the scientists. These 'good' wastewater treatment animals are commonly found in commercial aerobic wastewater treatment systems but not in residential septic system drainage fields.

"A healthy, diverse ecosystem is a new and significant finding, one worth investigating further. It could mean enhanced wastewater treatment for drainlines using tire chips," said Grimes.

Steve Steinbeck, Environmental Health Program Specialist with DEH, summarized it this way: " The use of tire chips meeting innovative product approval over the common use of rock aggregate produces higher porosity or voids and reduced fines [silt or clay] that may clog infiltrative surfaces or trench bottoms. Tire chips are cleaner, have more temporary storage space, and are more biologically active than conventional rock systems."

And then there are the additional environmental benefits tire chips will bring. Scrap tires are a serious environmental problem, both in the United States overall and in North Carolina. The Environmental Protection Agency estimates that one tire is scrapped for each person living in the United States, each year—over 260 million tires annually. In North Carolina, approximately 9.3 million tires were scrapped in legal landfills during the 2001-2002 fiscal year.

Scrapped tires can also be found in illegal dumpsites, some of which contain thousands of tires. While the number of these sites has decreased in recent years, due to targeted efforts by the Division of Waste Management, those remaining can cause a variety of problems, from releasing petroleum and other contaminants during tire fires to serving as mosquito breeding grounds and increasing the spread of disease.

"With this approval of tire chips [for use in septic systems], everyone wins—the state,

continued on page 7

N.C. Approval of Tire Chips for Use in Septic Systems - continued

counties and taxpayers," said Brad Atkinson, Non-Point Source Pollution Coordinator with the Division of Waste Management. "Converting scrap tires into a marketable product reduces North Carolina's dependence on scrap tire landfills." Atkinson continued. "In turn, it will also reduce the threat of catastrophic groundwater, surface water and air pollution resulting from tire fires. Reducing their likelihood is an important benefit of using tire chips in this way."

Tires can also serve as reservoirs for rainwater and act as ideal breeding grounds for mosquitoes. Increasing the mosquito population also increases the spread of the diseases—such as West Nile Virus— that they can carry. Removing the tires can reduce mosquito populations and thus reduce incidence of these diseases, a major health benefit for the citizens of North Carolina.

"The more tires we can get out of backyards, service stations, and dumps, the better. Tires are a constant problem as mosquito breeding grounds, one we've been fighting against for years. Hooray for tire chips!" declared Dr. Nolan Newton, Chief of the Public Health Pest Management Section of the Division of Environmental Health.

And last but definitely not least in these times of financial belt-tightening, tire chips bring economic benefits as well. The amount of tire chips needed for a residential septic system's drainage trench weighs approximately one third that of an equivalent load of gravel, which translates into lower hauling costs and savings for the consumer. The chips themselves also cost less than gravel, as they come from a sustainable, constantly replenished source.

Tire chips hold the first generic product approval given under the innovative systems program, meaning that no one has proprietary rights over the process, and that others wishing to manufacture the chips may apply to do so without paying royalties for use of the technology. Currently, there are only three operators in North Carolina producing tire chips for septic systems.

Prior to their approval for use in North Carolina, all chips made here were shipped to South Carolina and Virginia. This means that the potential exists for more operators to enter the market should demand rise, and that they could do so with relative ease. New businesses bring new jobs, a valuable commodity in the current economy.

The approval of the humble tire chip will yield some significant benefits, both environmental and economic, for North Carolina in the near future.

For more information on tire chips, please visit the Onsite Wastewater Section's Web site at http://www.deh.enr.state.nc.us/oww/index.htm.

Technical Report #12

Preliminary Investigation of Tire Shreds for Use in Residential Subsurface Leaching Field Systems

October 1999

Preliminary Investigation of Tire Shreds for Use in Residential Subsurface Leaching Field Systems

Sukalyan Sengupta, Ph.D., P.E.
and
Heather J. Miller, Ph.D., P.E.

Department of Civil Engineering
University of Massachusetts Dartmouth

Chelsea Center for Recycling and Economic Development Technical Research Program

October 1999

 This project was funded by EOEA through the Clean Environment Fund, which is comprised of unredeemed bottle deposits.

The Chelsea Center for Recycling and Economic Development, a part of the University of Massachusetts' Center for Environmentally Appropriate Materials, was created by the Commonwealth of Massachusetts in 1995 to create jobs, support recycling efforts, and help the economy and the environment by increasing the use of recyclables by manufacturers. The mission of the Chelsea Center is to develop an infrastructure for a sustainable materials economy in Massachusetts, where businesses will thrive that rely on locally discarded goods as their feedstock and that minimize pressure on the environment by reducing waste, pollution, dependence on virgin materials, and dependence on disposal facilities. Further information can be obtained by writing the Chelsea Center for Recycling and Economic Development, 180 Second Street, Chelsea, MA 02150.

Table of Contents

1. Abstract

Scrap tires pose a significant environmental and public health problem. A number of applications of this material have been attempted, such as tire-derived fuel, artificial reefs and breakwaters, leachate collection systems in landfills, and highway applications, but they cannot reuse the enormous amount of tires discarded every year, much less the stockpiles that exist from past disposal. An interesting application could be the use of scrap tire chips in lieu of crushed stone aggregate in residential subsurface leaching field systems. Some states in the nation permit this activity but at present it is not allowed in the Commonwealth of Massachusetts. The regulatory agencies of Massachusetts (primarily Massachusetts Department of Environmental Protection - MassDEP) would like to know the adverse effects, if any, of the use of scrap tire chips in residential leaching field systems. The two primary concerns are i) does the material leach contaminants from its surface which can affect groundwater quality, and ii) does the material provide similar performance as a conventional leaching field system. This study details the results of laboratory-scale experiments conducted to answer questions of leachate only. A field-scale study is planned to answer the performance question and to obtain more practical answers regarding the leachate.

2. Background

2.1 General

It is estimated that about 250 million tires are discarded annually in the United States. Tires are manufactured from rubber that is sulfur-vulcanized. This process of vulcanization changes the rubber from a thermoplastic, which can be reprocessed many times, to a thermoset, which can be shaped only once (Liu, et al., 1998). This is the primary reason that scrap tires cannot be reused or recycled easily. Scrap tires represent a significant municipal solid waste problem because they are often placed in stockpiles which pose fire hazards and serve as breeding grounds for rodents and mosquitoes. In lieu of stockpiling scrap tires or placing them in already overcrowded landfills, a number of applications that reuse them have been attempted. These include tire-derived fuel, recycled rubber products, artificial reefs and breakwaters, daily cover and/or leachate collection systems in landfills, and numerous highway applications (crumb rubber asphalt pavement, lightweight fill for embankments and behind bridge abutments, roadbed insulation, etc.). A potential end market, which has not yet received much attention in most states, is residential subsurface leaching field systems.

South Carolina has been the leader in promoting the use of scrap tires in place of aggregate in residential subsurface leaching field systems. State officials estimate that in South Carolina, approximately 1,875 "tire chip" systems are installed annually, which represent about 8.2% of the total number of septic systems installed there. These systems use about 1.5 million scrap tires per year. In the Commonwealth of Massachusetts, it is estimated that six million tires are discarded annually (Liu, et al., 1998). If Massachusetts codes were to allow the use of tire chips in residential septic systems, the potential would exist for about 25% of its scrap tires to be reused in these systems (assuming that about 2,000 tire chip systems were installed annually).

Although several states now have guidelines regarding the use of tire chips in residential subsurface leaching field systems, very little research has actually been completed to study their performance, and to investigate the potential for leaching of contaminants from the tire shreds.

Therefore, the purpose of this project was to conduct a preliminary investigation of the use of tire chips instead of gravel in residential subsurface leaching field systems.

2.2 Summary of Guidelines Existing in Other States

Seven states currently have guidelines or specifications regarding the use of tire chips in residential subsurface leaching field systems (Florida, Georgia, South Carolina, Virginia, Iowa, Texas and Kansas). Although statewide guidelines exist in those states, local (city or county) officials often have the authority to grant or deny the final permit for any individual septic system. Of the states with guidelines, four (Georgia, South Carolina, Virginia and Kansas) have essentially the same specifications, which require the following:

1. Chip size must be between ½ inch and 2 inches (Georgia) and between ½ inch and 4 inches (South Carolina, Virginia and Kansas).
2. Wire strands may not protrude more than ½ inch from the sides of chips.
3. At least 90% of the chips (by weight) must meet the specifications listed in items 1 and 2 (Georgia, South Carolina, and Kansas). At least 95% of the chips must meet the specifications listed in items 1 and 2 (Virginia).
4. "Fines" are prohibited. Fines are generally defined as particles or substances that can settle to the bottom of the absorption trench and contribute to clogging or blocking of infiltrative surfaces. Examples include dust, dirt, grit, and similar substances.
5. The top surface of the chips in the leaching trenches must be covered with a geotextile fabric prior to backfilling to help preclude soil from infiltrating into the tire chips.

The guidelines in Iowa and Texas are more abbreviated. Iowa specifies a tire chip size between one and three inches, with no other material restrictions. Texas guidelines call for a "2-inch minus" chip size, with the stipulation that larger sizes may be approved on a case-by-case basis by the permitting authorities. A tire chip is considered "2-inch minus" if it is no greater than 2 inches on a side (including protruding wires), or if it can pass through a 2-inch by 2-inch sieve aperture. The Texas guidelines also call for a geotextile separator.

Florida has perhaps the most elaborate specifications, which are partly based upon their state Department of Transportation (FDOT) "Standard Specifications for Road and Bridge Construction", 1991. Gradation requirements for various sieve sizes ranging between 3/16 inch and 2 inches are provided. They limit the fines content to less than 3.75%, they require at least 80% of the bead wire to be removed from the tires, and they prohibit exposed wire from protruding more than ½ inch from the sides of chips. Other material properties are required in accordance with the FDOT specifications (i.e., limits on deleterious substances, Los Angeles Abrasion, soundness, and percentage of flat or elongated pieces). Tire chip installation is restricted to sites where the bottom surface of the drainfield is at least 24 inches above the water table elevation in the wettest season of the year. And finally, manufacturers wishing to provide tire chips must receive a letter of approval from the state of Florida, and must label the chips in a specified manner.

2.3 Review of Applicable Literature

Two primary issues need to be addressed with regard to use of tire shreds in septic systems. First, will they serve the same function as aggregate in terms of drainage? And second, will potentially harmful contaminants leach from the tires? There is little debate regarding the first question. Although use of tire shreds in septic systems is not well documented, their use in other civil engineering drainage applications has been extensively investigated. Tire shreds have been used as edge drains along roadways and as drainage layers beneath roads. They have also been used as drainage media in leachate collection and removal systems in landfills.

Humphrey (1998) summarized hydraulic conductivity (permeability) values reported in the literature from various researchers. Hydraulic conductivity is a measure of the ease with which a fluid moves through porous media. The hydraulic conductivity of tire shreds is generally much greater than most granular soils. Hydraulic conductivity is not an inherent property, but will vary depending upon numerous factors, including particle size distribution, porosity, and applied normal load (especially for tire shreds, which are very compressible). The various researchers tabulated in Humphrey (1998) report hydraulic conductivity values ranging between 0.58 cm/sec and 23.5 cm/sec for tire shreds between 0.75 and 3 inches in size. Most of those reported values were all above 1.0 cm/sec, which is considered a "benchmark" value in geotechnical engineering. For example, 1.0 cm/sec is the approximate boundary between laminar and turbulent flow, and separates clean sands from clean gravels (Holtz & Kovacs, 1981). The reported data indicate that tire shreds should provide more than enough flow capacity for use in septic systems.

The second issue, regarding potential contamination, is more difficult to address. Because tire shreds have been used in a number of civil engineering applications where water may pass through the shreds and infiltrate the groundwater table below, there has been much concern regarding potential leaching of contaminants. To address these concerns, there have been several studies published in the literature. The most significant of these include:

- Minnesota Pollution Control Agency Study (1990); included both lab and field leaching tests.
- Wisconsin DOT Study (Edil, et al., 1992); included both lab and field leaching tests.
- Virginia DOT Study (Balding, 1992); lab leaching tests.
- Rubber Manufacturers Association (RMA)/Scrap Tire Management Council Study (Zelibor, 1991); lab leaching tests.
- Studies completed at the University of Maine (Humphrey, et al., 1997); field leaching tests.

A detailed review of these (and other) studies is presented by Liu, et al. (1998), and will not be repeated here, but a brief summary follows. In general, these studies indicated that leachate derived from scrap tires is "safe," however the different studies used various standards for comparison, and minor contradictions exist within the data.

In terms of the lab leaching tests, most pollutants leached from tire shreds were generally below the various regulatory limits, except in studies conducted under extreme pH conditions. The Scrap Tire Management Council Study (Zelibor, 1991) found that Toxicity Characteristic

Leaching Procedure (TCLP) regulatory limits were not exceeded for any compounds. The Wisconsin study indicated that most compounds showed declining concentrations with continued leaching, except for iron, manganese, barium and zinc, which showed the opposite trend. Iron and manganese were at or slightly above their applicable drinking water standards, while barium and zinc remained below their applicable drinking water standards.

The Minnesota Pollution Control Agency Study (1990) and the Virginia DOT Study (Ealding, 1992) both indicate that, in the laboratory, metals are leached at higher concentration under low pH conditions, while organics are leached at higher concentration under more basic conditions. Although none of the leachate samples exceeded the Extraction Procedure (EP) toxicity criteria or the TCLP criteria, the following metals exceeded the Minnesota Recommended Allowable Limits (RALs) for drinking water: arsenic, cadmium, chromium, selenium, and zinc. The iron level was also much higher than the Secondary Maximum Contaminant Level (SMCL). In terms of organics, concentrations of total petroleum hydrocarbons (TPHs) and polynuclear aromatic hydrocarbons (PAHs) were measured. The Minnesota Recommended Allowable Limits (RALs) were exceeded for both List 1 (carcinogenic) and List 2 (noncarcinogenic) PAHs. It should be noted that these studies were conducted under extreme pH conditions to evaluate worst-case scenarios and may not be representative of actual conditions in "scrap tire" application areas.

A substantial amount of field data on groundwater samples has been collected at sites where tire shreds have been used as fill material for roadways or embankments (Minnesota Pollution Control Agency Study (1990), Wisconsin DOT Study (Edil, et al., 1992), University of Maine (Humphrey, et al., 1997)). The data obtained from the field studies is somewhat more contradictory. This is probably due to the fact that conditions in the field are less controlled, and groundwater samples may sometimes become polluted from sources other than just the tire shreds under study. For example, in the Minnesota Study, groundwater samples exceeded the Minnesota drinking water Recommended Allowable Limits (RALs) for barium, cadmium, chromium, lead, and List 1 and List 2 PAHs. In contrast, in the Wisconsin Study (1992) it was concluded that there was no significant leaching of substances that warrant public health concern such as lead or barium. These two studies had relatively poor experimental controls, and it has been suggested that contamination may have resulted from other sources at those sites.

The results obtained from the University of Maine (Humphrey, et al. (1997)) are probably more reliable, because control basins were installed at the test site in North Yarmouth, to distinguish between compounds that leached from the tire shreds, and those that were naturally present in the water there. The University of Maine data is more extensive than most of the other field studies. Samples collected on a quarterly basis since January, 1994 were analyzed for metals with primary and secondary drinking water standards. The data indicate that, for the metals with a primary standard, the presence of tire shreds did not increase concentrations significantly above levels occurring naturally at the site. For metals with a secondary standard, iron levels beneath the tire shred fills were elevated on two dates, and manganese showed consistently higher concentrations in the basins overlain by tire shreds compared to the control basins. It should be noted that secondary drinking water standards are based upon aesthetic concerns; although they may impart some taste, odor, or color to the water, they do not pose a known or suspected health risk. Humphrey, et al. also obtained samples that were tested for volatile and semi-volatile organics on two dates, and found all substances below the test method detection limit. Based

upon those results, Humphrey concluded that "tire shreds have a negligible impact on groundwater quality and can be used for most civil engineering applications provided the pH of the groundwater is near neutral."

Published results could be located from only two field studies in which tire shreds were used in place of aggregate in septic systems. The first report was by Chennette Engineering, Inc. (1992) in Montpelier, Vermont. The system was built to replace an existing residential (four bedroom) septic system that had failed. The replacement system consisted of two trenches. Each trench was 4 feet wide by 70 feet long, with a 12-inch thick layer of tire shreds placed around the drainpipe. Two-inch nominal tire shreds were used in lieu of crushed stone. Two lysimeters were installed to allow sampling of treated effluent at a depth of 36 inches below the bottom elevation of the tire shreds. The lysimeters were placed so that they would sample the treated effluent before it was diluted by contact with groundwater.

The system was put into service on November 25, 1991, with the first round of sampling performed in early December 1991. Sampling was performed approximately monthly through June 1992. Samples were tested for twelve metals. Eight of them, arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, and nickel, have a primary drinking water standard. Testing was also performed for iron, silver and zinc, which have a secondary drinking water standard. Of the metals analyzed, all were present at negligible concentrations except for iron and lead, which were initially measured at 0.43 mg/l and 0.038 mg/l, respectively. These elevated concentrations dropped below the applicable groundwater standards of 0.3 mg/l and 0.015 mg/l, respectively within one to two months. Since no control wells were installed in this study, it is difficult to say whether the elevated levels were due entirely to the tire shred installation.

A second tire shred system is reported by Burnell and McOmber (1997). They describe an experimental drainfield constructed at the Southern Idaho Regional Landfill. In addition to constructing a trench using chipped tires, a control trench was also constructed using standard drainrock. Each trench was about 3 feet wide by 30 feet long, with a 12-inch thick layer of drainage media (tire shreds or standard drainrock) placed around the drainpipe. The wastewater source was from the landfill's main office, scale house, and public restroom. Unfortunately, this wastewater did not have typical wastewater strength or flow characteristics. The authors estimated that the Biochemical Oxygen Demand (BOD) in the dosing chamber was only 23% of a "typical" residential system, and the TSS only 33% of a typical system. Wastewater flow rates were less than 100 gallons per day (GPD).

The system was run for four weeks, and then a leak in the septic tank was discovered and repaired. After that, another four-week start-up period ensued, and then sampling was initiated. Samples were tested for selected heavy metals, BOD, Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), sulfate, phenols and trihalomethanes. The BOD decreased in both the tire-shred trench and the control trench as compared to the dosing chamber. The COD decreased in the control trench, but remained nearly the same in the tire shred trench as compared to the dosing chamber. Suspended solids were very low in all cases. All samples tested for trihalomethanes were below the method detection limit. Phenols were above the method detection limit, but were about the same in both the control trench and the tire shred trench.

Sulfate remained the same from the dosing chamber to the control trench. The tire shred trench showed an increase in sulfate concentration compared to the dosing chamber, although sulfate levels in the tire shred trench were still below the secondary drinking water standard of 250 mg/l. Cadmium, chromium and lead were below the detection limit for all samples. Copper was slightly elevated in the tire-shred trench, but was very low and close to the detection limit. The two metals that exhibited markedly elevated concentrations were iron and zinc. The iron concentration in the tire shred trench was three times that measured in the dosing chamber, and exceeded the secondary drinking water standard of 0.30 mg/l. The zinc concentration in the tire shred trench (0.62 mg/l) was about seven times the concentration measured in the dosing chamber, but was still well below the secondary drinking water standard of 5 mg/l. It should be noted that both iron and zinc concentrations in the control trench were slightly higher than the corresponding concentrations in the dosing chamber, though much lower than the corresponding concentrations in the tire shred trench.

In conclusion, the drainage capacity of tire shreds is well documented, and the reported data indicate that tire shreds should function as well as aggregate in terms of flow requirements in residential septic systems. The question of whether tire shreds may leach potentially harmful contaminants is not completely resolved. In general, the published laboratory and field studies indicated that leachate derived from scrap tires is "safe," however minor contradictions exist within the data. In most cases (when the pH of the water is near neutral), compounds which tend to leach from tires affect only the aesthetic quality of the groundwater. In other words, although they may impart some taste, odor, or color to the water, they do not pose a known or suspected health risk. Due to the limited nature of much of the reported research, further study is warranted to examine the long-term durability and potential leaching characteristics of tire shreds placed in residential subsurface leaching field systems.

3. Scope of Work

The overall goal of this project was to conduct a preliminary investigation of the use of two-inch waste tire chips instead of gravel in residential subsurface leaching field systems. The scope included compilation of available technical information in this area, and investigation of chemical properties of leachate generated when synthetic solutions of varying pH are passed through tire chip material. Accelerated leaching tests were conducted in the Environmental Engineering Laboratory at the University of Massachusetts Dartmouth to determine:

- What contaminants (organic and inorganic) leach out from the scrap tire material?
- What is the profile of leachate generated with time?

Based upon the limited timeframe, this project was intended to be a preliminary investigation to provide useful data for field-scale testing that is anticipated for FY 2000.

4. Approach to Work and Work Completed

Laboratory Scale Experiments

The tire chip samples were obtained from New Bedford Tire and Recycling, located at 680 Acushnet Avenue, New Bedford, MA. New Bedford Tire and Recycling processes 3,500,000 to 4,000,000 million tires a year, of which 90% are radial tires. The tires are sorted based on bias ply (non-radial) or radials. The sorted tires are then conveyed to large grinding hoppers. The produced chips can then be reground to obtain a desired size, with a minimum of ¾". Each size is collected and stockpiled for later use. Since the focus of this study was to find the concentration of inorganic leachates from the scrap tires, we chose the smallest particle size, ¾", as it would provide the maximum surface area per unit weight. The obtained sample included ¾" steel belted tire chips (to get maximum iron concentration in the leachate) with a trace of fine particles.

5. Results

5.1 Experimental Setup

All the analytical methods used in this project conformed to the specifications contained in the Standard Methods for the Examination of Water and Wastewater (20^{th} edition) or the Hach Colorimeter Procedures manual.

Effect of pH

The first experiment was conducted to determine the effect of pH on inorganic leachate quality. Five random tire chips were placed into each of two 250 ml Erlenmeyer flasks with an additional flask setup as a blank standard. The flasks were filled to capacity with distilled water. The pH of one of the tire chip flasks and the standard were measured at 6.2. The pH of the third flask was adjusted to 3.5 using Nitric Acid (HNO_3). The flasks were placed on the Innova 2100 Platform Shaker and allowed to shake for approximately 18 hours. This allowed ample time for the tire surface to attain equilibrium with the aqueous solution.

After the mixing was complete, the samples were vacuum filtered through a 0.45-micron filter for further analysis. Each filtered sample was then digested by the Nitric Acid Digestion method according to method 3030 E (Standard Methods). The digested samples were then analyzed for aluminum, chromium, copper, iron, manganese, and zinc. The non-metal testing included tests for sulfate and chloride that were performed on non-digested samples. The sulfate test analysis used the sulfate method, 8051; the chloride test was performed according to the Argentometric Method of the Standard Methods Manual Test 4500-Cl^- B. A summary of all the methods used is described in the next section. The results of all tests performed are listed in Table I.

Table I
Characteristics of Inorganic Constituents of Leachate from Batch-Scale Equilibrium Tests
all values are in mg/L

Sample/Test	Fe TPTZ	Fe FerroZine	Al	Mn	Zn	Cu	Cr	Cl^-	SO_4^{2-}
Blank	0.78	0.90	0.00	0.01	0.09	0.72	0.04	-	0.00
pH 6.4	0.95	0.93	0.47	0.00	0.37	0.64	0.08	272.97	0.00
pH 3.49	7.03	6.93	0.18	0.02	0.50	2.36	0.04	49.63	0.00
Drinking Water Quality Standard (DWQS)	0.3†	0.3†	<0.05‡	0.05†	5.0†	1.0†	0.1	250†	250†

†- Secondary Maximum Contaminant Level Limit based not on adverse public health effect but on aesthetic concerns.
‡ - Goal set by American Water Works Association, to which its members try to adhere.

Each sample collected above was also analyzed for Total Phenolics according to EPA Method 420.1/420.2. The results are shown in Table II.

Table II
Concentration of Total Phenolics in Leachate from Batch-Scale Equilibrium Tests

Sample	Total Phenolics (mg/L)
Blank	0.005
pH 6.4	0.01
pH 3.49	0.007
DWQS	0.001†

† - Based on pentachlorophenol

Column Leachate
After the preliminary testing to determine the effect of pH, a new set of chips was used to study the characteristics of column leachate. These chips were placed into a Plexiglas® column 83.8 cm high with a 15.23-cm inner diameter for a total volume of 6.1 L. The column was open to air at the top with a small opening at the base of the column. The column was filled 2/3 of the height with tire chips. The column was filled with distilled and deionized water to a level a little higher than the tire chips to keep the tire chips totally submerged. The water was left in the column for 4 days. The pH of the influent water was 6.4 and the same pH was recorded for the effluent. Five samples, each of approximately 850 ml in volume, were collected and analyzed for inorganic contaminants along with a blank standard of distilled and deionized water. 300 ml of the 850 ml sample volume was digested using the Nitric Acid Digestion Method mentioned before. The tests for metals and non-metals were then performed as described in the next subsection. The results are displayed in Table III.

Table III
Analysis of Tire-Chip-Column Leachate
Influent pH = Effluent pH = 6.4
all values are in mg/L

Sample/Test	Fe-TPTZ	Fe-FerroZine	Mn	Al	Cr	Cu	Zn	Cl^-	SO_4^{2-}
1	7.10	7.04	0.78	0.27	0.19	0.13	1.06	18.74	15.00
2	6.82	6.72	0.77	0.15	0.07	0.15	1.06	3.75	16.00
3	7.12	7.37	0.70	0.42	0.05	0.20	1.13	14.99	17.00
4	7.42	9.29	0.71	0.48	0.02	0.27	1.11	18.09	17.00
5	6.46	5.83	0.70	0.36	0.14	0.16	0.70	4.25	16.00
Blank	0.03	0.01	0.02	0.00	0.01	0.03	0.02	-	0.00
DWQS	0.3†	0.3†	0.05†	<0.05‡	0.1	1.0†	5.0†	250†	250†

†- Secondary Maximum Contaminant Level Limit based not on adverse public health effect but on aesthetic concerns.
‡ - Goal set by American Water Works Association, to which its members try to adhere.

Once the initial column tests were complete, the column was refilled with distilled and deionized water that was adjusted to a pH of 3.0 using Reagent Grade HNO_3. The tire chips were submerged for 26 hours. Six samples and a standard blank of approximately 850 ml were collected and tested as described below. The results are displayed in Table IV.

Table IV
Analysis of Tire-Chip-Column Leachate
Influent pH = 3.0 Effluent pH = 6.0
all values are in mg/L

Sample/Test	Fe-TPTZ	Fe-FerroZine	Mn	Al	Cr	Cu	Zn	Cl^-	SO_4^{2-}
1	10.97	9.74	0.64	0.24	0.01	0.26	1.58	2.50	0.00
2	15.31	11.16	0.61	0.11	0.01	0.33	1.39	2.50	0.83
3	17.26	13.75	0.59	0.20	0.01	0.40	1.13	1.30	0.00
4	14.27	10.07	0.59	0.12	0.00	0.13	1.28	0.90	0.00
5	18.26	12.84	0.63	0.11	0.00	0.20	1.50	8.50	0.00
6	12.99	10.25	0.62	0.79	0.00	0.17	1.56	1.35	0.00
Blank	0.09	0.08	0.00	0.06	0.01	0.08	0.04	-	0.00
DWQS	0.3†	0.3†	0.05†	<0.05‡	0.1	1.0†	5.0†	250†	250†

†- Secondary Maximum Contaminant Level Limit based not on adverse public health effect but on aesthetic concerns.
‡ - Goal set by American Water Works Association, to which its members try to adhere.

Due to sample limitations, in some case small amounts of the sample were used and appropriately diluted with distilled and deionized water to its respective test size for the colorimeter.

5.2 Summary of Methods

Aluminum (Method 8012): The sensitivity of this method is from 0.0 to 0.80 mg/L. The aluminum indicator reacts with the aluminum in the sample to produce an orange color. The darkness of the color is a direct correlation to the concentration of aluminum. Ascorbic acid is added to remove any iron interference.

Chromium (Hexavalent, Method 8023): The sensitivity of the test is from 0.00 to 0.60 mg/L. The reagent used contains an acid buffer combined with 1,5-diphenylcarbohydrazide, which forms a purple color when chromium is present.

Chromium (Total, Method 8024): Sensitivity of 0.00 to 0.60 mg/L. Trivalent chromium is oxidized to the hexavalent form. Once in the hexavalent form, the sample is treated as above.

Copper (Method 8506): Sensitivity of 0.00 to 5.00 mg/L. Copper reacts with a salt of bicinchoninic acid, contained in the reagent. The reaction forms a purple color, which is proportional to the copper concentration.

Chloride (Argentometric Method, 4500-Cl^- B): A titration of the sample using potassium chromate as the indicator and silver nitrate as the titrant. The silver reacts with the chloride to form silver chloride, which precipitates before red silver chromate is formed.

Iron (FerroZine Method 8147): Sensitivity of 0.000 to 1.300 mg/L. This test forms a purple colored complex with trace amounts of iron. The sample is buffered to 3.5.

Iron (TPTZ Method 8112): Sensitivity of 0.00 to 1.80 mg/L. The indicator is combined with a reducing agent to convert all iron in the sample to a ferrous state. The indicator forms a deep blue to purple color in the presence of ferrous.

Manganese (Low range Method, 8149): Sensitivity of 0.000 to 0.700 mg/L. Ascorbic acid is used to reduce all oxidized forms of manganese to Mn^{2+}. Alkaline – cyanide is added to mask potential interference. The PAN indicator is added and binds to Mn^{2+} to form an orange complex.

Sulfate (Method 8051): Sensitivity of 0 to 70 mg/L. The sulfate in the sample reacts to the barium in the reagent to form an insoluble compound, barium sulfate. The amount of turbidity is proportional to the amount of sulfates in the sample.

Zinc (Method 8009): Sensitivity of 0.00 to 3.00 mg/L. The metals in the sample react with the cyanide in the reagent. Cyclohexanone selectively breaks the bond between the zinc and cyanide. The zinc then reacts to the 2-carboxy-2-hydroxy-5-sulfoforamazyl-benzene indicator and forms a blue color.

6. Lessons Learned

- Scrap tire chips leach metals and inorganic non-metallic ions but the only constituents that are leached in significant concentration are iron, manganese, chloride, and sulfate, all four of which are regulated under Secondary Drinking Water Standards. Thus, scrap tires, when used instead of aggregate in residential subsurface leaching field systems, most probably will not affect Primary Drinking Water Standards.
- Scrap tire chips have limited Acid Neutralizing Capacity (ANC); therefore, it is expected that when the scrap tire surface is exposed to an acidic solution, it can arrest the decrease in pH to some extent. Preliminary experiments indicate an Acid Neutralizing Capacity of approximately 9.5 E-03 milliequivalents/dry gram of scrap tire. The effect is that the inorganic constituents (primarily metals) will not be leached out at the beginning of the contact cycle at maximum concentration. The maximum concentration of the metals in the leachate will be manifested after the tire surface has been exhausted of its ANC.
- The primary inorganic anions present in the leachate, chloride and sulfate, show a decreasing concentration profile with increased volume of distilled/deionized water passed, whereas the metals concentration shows a consistent leachate concentration with increased volume of distilled/deionized water passed. This observation suggests that metals will be present in the leachate at a consistent concentration for a much longer time than will inorganic nonmetallic constituents such as chloride and sulfate.

7. Transferability of this Research

Since this research was performed on a laboratory scale with reagent grade materials and distilled and deionized water, it may be surmised that the results obtained can be used for other scrap tire applications where the quality of leachate generated is a primary concern.

8. Recommendations for Future Work

As mentioned before, the results of this work have to be complemented and supplemented with field scale studies using septic tank effluent (instead of distilled/deionized water) and with monitoring of the leaching field effluent. These studies should be performed not only for the analytes mentioned in this report but also for pollutants such as BOD, COD, TSS, Total Kjeldahl Nitrogen (TKN), Total Phosphate (TP), etc. The results of field-scale tests in combination with this report, will allow the regulatory agencies to answer the two fundamental questions listed at the beginning of this report, and consequently help make the decision of whether to allow scrap tire chips in residential sub-surface disposal systems.

9. Conclusions

Scrap tire chips leach inorganic metals and non-metallic anions when distilled/deionized water is contacted with it, either in batch-equilibrium or column-run mode. However, the concentration of the leachate constituents does not violate Primary Drinking Water Standards. With regard to Secondary Standards, iron, manganese, chloride and sulfate appear to be of main concern. Chloride and sulfate show a decreasing concentration profile with increasing volume of water contacted.

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