TIRE CHIP SUBSTITUTION FOR ROCK AGGREGATE in Onsite Septic System Nitrification Drainfields

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NCDENR

TIRE CHIPS in ONSITE

- Tire chip trio
  (soil scientist, geologist, biologist)
- One truckload tire chips/one system
- Tire chip samples
  - No fines
  - Some attached by wires

TIRE CHIPS in ONSITE

- Installation of tire chips
- Covering with geotextile fabric
- One line completed

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- Excavations

Mobile Home Park

Horry County, SC

- Microscopic Evaluation at site

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Scrap Tire Supply

- EPA estimates one scrap tire/person/year
- NC 1999-2000: 9.5 million tires

  136,536 tons in monolandfills
- Prior to approval in NC, all chipped tires in NC shipped to SC for onsite systems
- e.g. Septic System Tire Chip Yearly Use:
  - Georgia 2.3 million tires
  - Florida 100 million tires
  - Iowa 300 tons
  - Oklahoma 30% of recycled tires

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Physical Description (1)

Per Tire Weight:

- Passenger Tire 18.8-21 pounds
- Truck Tire about 100 pounds

Cubic Yard:

- Stone aggregate: 2,800 lbs
- Tire chips (2”): 800 lbs

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Basic Ingredients of Passenger Tire

Fabric (combo of steel, nylon, aramid fiber, rayon, fiberglass, or polyester)

Rubber Reinforcing (natural and synthetic - hundreds of polymer types)

Chemicals (carbon black, silica, resins)

Anti-Degradants (antioxidants/ozonants, paraffin waxes)

Adhesion Promoters (cobalt salts, brass on wire, resins on fabrics)

Curatives (cure accelerators, activators, sulfur)

Processing Aids (oils, tackifiers, peptizers, softeners)

(TRNCC)

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Composition - One Passenger Tire (TRNCC)

- By Weight:
  - 30 synthetic rubbers — 5 lbs.
  - 8 types of natural rubbers — 4 lbs
  - 8 type of carbon black — 5 lbs
  - steel cord for belts — 1 lb
  - polyester and nylon — 1 lb
  - steel bead wire — <1 lb
  - 40 chemicals, waxes, and oils etc. — 3 lbs
- Percentage Rubbers
  - natural rubber 55% synthetic rubber 45%
- By Percentages:
  - Carbon — 85%
  - ferric material — 10 - 15%
  - sulfur — 0.9 - 1.25%

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States Permitted

- Approximately 17 states Approved/Using
  (5 require approval on a site by site basis)
- Interest in 13

- Approved SE
  - North Carolina ***(October 24, 2002)***
  - South Carolina
  - Virginia
  - Georgia
  - Florida
- Not approved
  TN(*University of Buffalo Survey , 1998-99*)

TIRE CHIPS in ONSITE

Definitions of Chips and Shreds

Both terms chips and shreds are used in states rules for stone aggregate substitution.

- Chips (most used and best term):

  "A classified scrap tire particle … … . which is generally two inches (50.8mm) or smaller and has most of the wire removed. "

- Shreds:

  "Pieces of scrap tires … … .. are generally between 1.97" (50mm) and 12" (305mm) in size."

  NYS Roundtable Report 1999

TIRE CHIPS in ONSITE -Caution-

- Handling tire chips -
  - Heavy gloves due to protruding wires
- Proper protective clothing
  - Including heavy shoes
- Cleanup by installer
  - Required removal of all stray chips

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Performance

Spagnoli, Weber, Zicari 2001. Based on literature review, and the results of pilot and full-scale testing

loading - ponding - drainage

"Vertical and horizontal permeability of tire chips are equivalent to stone"

"Based on full - scale… … . distribution of wastewater to soil is equivalent to stone"

TIRE CHIPS in ONSITE

Performance

Spagnoli, Weber, Zicari 2001. Based on literature review, and the results of pilot and full-scale testing

Ammonification; Nitrification; BOD5

COD; TSS; fecal coliform reduction

Based on testing… .tire chip aggregate provides treatment of wastewater constituents equal to rock aggregate

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Leachates semivolatile or volatile organic compounds

Spagnoli, Weber, Zicari 2001. Based on literature review, and the results of pilot and full-scale testing

- experimental
- field data

"Leaching from tire chips under conditions operative in leachfields, does not contribute concentrations of semivolatile or volatile organic compounds which are a concern to groundwater."

Chemosphere 2000:

Ground rubber removed many VOC's and semiVOC's

TIRE CHIPS in ONSITE

Leachates- Metals

Spagnoli, Weber, Zicari 2001. Based on literature review, and the results of pilot and full-scale testing

"Leachates from tire chips under conditions operative in leachfields result in higher iron and manganese. Although elevated over stone, typically below secondary groundwater standards."

Chelsea Center 2000. Based in literature review and the results of pilot and full-scale testing

Iron - Tire chips acted as a "sink" for iron.

Manganese - high in the D-box, and equal concentrations in the tire chip and rock aggregate drainfields.

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Biomat/Biofilm Observations NC/SC

Tire Chips:

- Well developed dark biomat in 2 - 8 year old systems
- Tire chips coated with fuzzy biofilm

Rock Gravel:

- Well developed lighter biomat
- Gravel not coated with visible biofilm
- No biofilm adhering to the gravel

TIRE CHIPS in ONSITE

Tire Chip Durability NC/SC

- 2 year-old systems (NC)
  - still have wire - encrusted
  - chips not degraded

- 8 year-old systems (SC)
  - still have wires - encrusted
  - chips not degraded

TIRE CHIPS in ONSITE

- Clean chips before installation
- Tire chips from systems 8 years old Note: Fuzzy Biofilm on Chips

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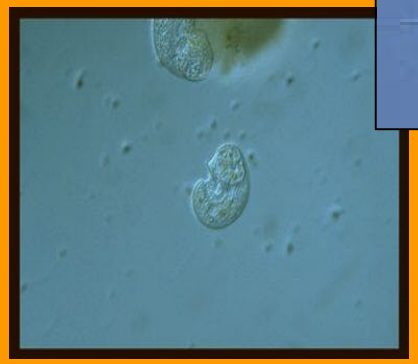
Macrobiology Results NC/SC

- Tire chips
  - protozoa, nematodes, oligochaetes,filter fly larva
  - in ponded tire chip drainfields - none
    (except some protozoa)
- Gravel
  - No macrobiota were found
  - Except possibly protozoa
    (maybe contamination)

TIRE CHIPS in ONSITE

Bugs in the Tire chip Trenches



- Ciliates
- Single cells:
  - -grazers
  - -particle feeders
  - -scavengers
- Found in tire chips wash/biomat

http://ebiomedia.com/gall/ciliates/

TIRE CHIPS in ONSITE

Bugs in the Tire chip Trenches

NEMATODES

- Common in activated sludge.
- Feeds on chunks of bacterial floc.
- Mineralization processes
- Aerate soil

http://www.yorkcity.org/cityservices/wwtp/micro.htm

TIRE CHIPS in ONSITE

Bugs in the Tire chip Trenches

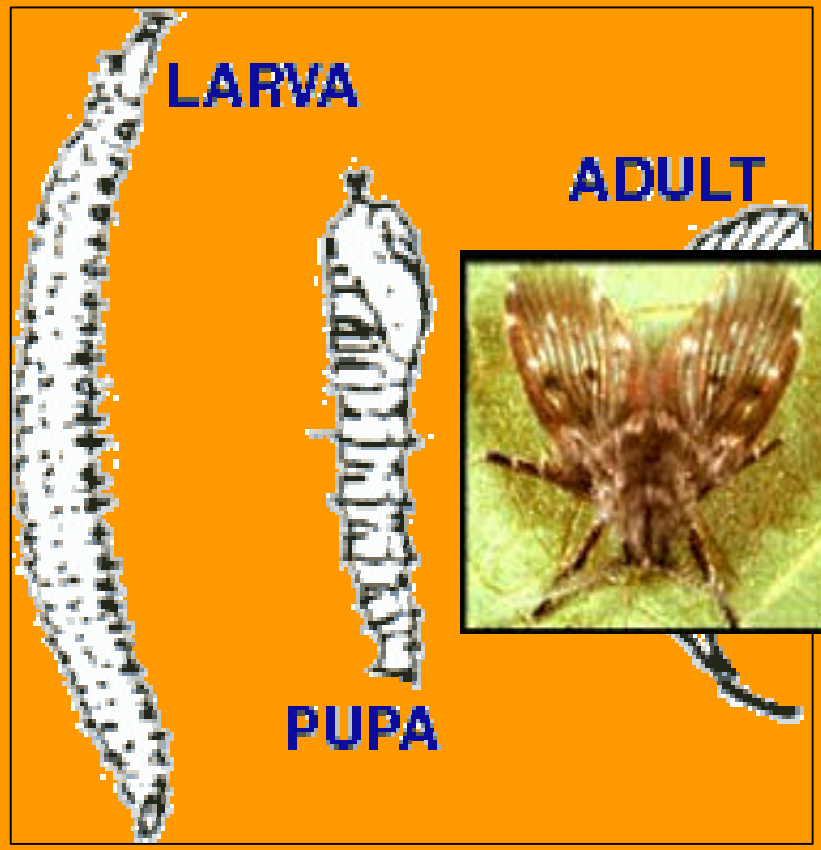
Oligochaete

- aquatic "earthworms"
- bristles on body
- plow through floc
- ingest chunks of floc

http://www.yorkcity.org/cityservices/wwtp/micro.htm

TIRE CHIPS in ONSITE

Bugs in the Tire chip Trenches



- Drain fly larva (1)
- Larvae graze on the biomat
- Adult normally =pest
- http://www.arrowpestcontrol.com/pages/drainfly.html

TIRE CHIPS in ONSITE

Significance of the Biology

Protozoa

Oligochaetes (mini earthworms)

Nematodes

Filter Fly larva

The Biology demonstrates the potential for enhanced treatment of wastewater, aeration of the biomat, grazing of the biomat, keeping biomat pores open, and ingesting floc that reaches the drainfield.

Conclusion: A healthy diverse ecosystem. bhg

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In Comparison of SE states' rules

Differences in language, percent compliance, approval of product

- Florida
- Georgia
- South Carolina
- Virginia

TIRE CHIPS in ONSITE

NC Specifications 1,2 ...

1. Shall be free (98% or better by weight) of balls of wire and fine rubber particles ;

2 . 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;

TIRE CHIPS in ONSITE

NC Specifications 3,4...

3. Shall be nominally two (2) inches in size and may range from ½ inch to a maximum of four (4) inches in any one direction (95% or better by weight);

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

TIRE CHIPS in ONSITE

NC Specifications 5,6

5. Shall not contain wire protruding more than one-half inch from the sides of the chips (95% or better by weight); and

6. Tire chip aggregate shipped for use in OSWS in NC shall be supplied by a DENR/DEH/OSWS approved tire processor, and accompanied by a bill of lading certifying the specifications.

TIRE CHIPS in ONSITE

In brief : Processor Approval

1. Processor submits sample to DEH - OSWS

2. Samples must be labeled with processor's information.

3. Samples analyzed for specifications by a qualified laboratory

4. Approved processors will be listed on the OSWS home page

5. Documentation of manufacturer's product shall be submitted - as requested - at least yearly to OSWS

6. Noncompliance with this approval may subject a tire processor to suspension or revocation of their approval.

TIRE CHIPS in ONSITE

Siting criteria

The standard requirements for the siting of wastewater systems as specified in 15A NCAC 18A .1900 *et seq.* shall apply, except as follows:

- **1.** Approved tire chip aggregate may be substituted for stone or gravel in subsurface sewage effluent absorption systems, required by 15A NCAC 18A .1900 *et seq*..
- **2.** The minimum vertical separation required by Rule 15A NCAC 18A .1955(m) SHALL NOT BE REDUCED, notwithstanding the use of any advanced wastewater treatment system.

TIRE CHIPS in ONSITE

Installation 1, 2...

- **1.** The installation requirements of 15A NCAC 18A .1900 *et seq*.

- **2**. 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 drainfield aggregate .
  - The bill-of-lading shall certify that the material meets the specifications for drainfield 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.

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Installation 3,4,5,6

- **3**. The tire chip aggregate 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. Specifications on next slide...
- **4.** All tire chips not used in the nitrification trench shall be removed from the site by the installer or contractor for the onsite wastewater system
- 5. No soil shall contaminate the tire chips during installation.
- **6.** For LPP systems, the orifices shall be protected from aggregate shadowing by sleeving the discharge pipe laterals within the perforated pipe [which meets Rule .1955(e)] typically used for conventional nitrification lines.

TIRE CHIPS in ONSITE

Non-Woven Geotextile Fabric NC Specifications

The tire chip aggregate 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 3.0 oz./yd^2 (ASTM D-5261),
- permittivity of at least 1.0 sec^{-1} (ASTM D-4491),
- trapezoid tear strength of at least 35 lbs. (ASTM D-4533)
- mesh size equal to U.S. Sieve No. 70 (A.O.S.)

(ASTM D-4751)**.

** *Note: Numerous manufacturers produce geotextile fabric that meets the designated ASTM standards for tire chip aggregate. Contact OSWS for further information if needed.*

TIRE CHIPS in ONSITE

Non-Woven Geotextile Fabric examples of suppliers meeting NC Specifications

These are not the only suppliers of fabric meeting specifications! Some examples:

1. Amoco 4546
2. Cultec 410
3. Linq 125 EX
   130 EX
   140 EX
4. Mirafi 140 NC
   140 N

TIRE CHIPS in ONSITE

APPROVED

Tire Chip Processors (NC)

- US Tire Recycling, L P: Tire Chip Aggregate Approval No. TCA-01

Street and mailing address: 6322 Poplar Tent Rd.,
Concord, NC, 28027-7730
Contact Persons: Mr. Bob Johnson, Mr. Scott Fowler
Phone: 704.784.1210 Fax: 704.784.4716
email: ustire@vnet.net

- Tire Disposal Service: Tire Chip Aggregate Approval No. TCA-02

Street Address: 5414 Waxhaw-Marvin Rd., Waxhaw, NC
Mailing Address: PO Box 987, Waxhaw, NC, 28173
Contact Person: Mr. George Dalton
Phone: 1.800.572.1927 or 704.843.4643 Fax: 704.843.5408
email: attiredisposal@aol.com

- Central Carolina Tire Disposal: Tire Chip Aggregate Approval No. TCA-03

Street and mailing address: 1616 McKoy Town Road ,
Cameron, NC 28326
Contact Persons: Mr. Tim McNeill, Mr. Thomas Womble
Phone: 919-499-2301 FAX : 919-499-4619
email: cct@wave-net.net

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SPECIAL THANKS!

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