Benefits of Synthetic Tie Plugging

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Synthetic Tie Plugging

- Introduced in 1979 by Tamper Inc. on the Canadian Pacific Railroad. The product was a urethane foam.
- A solid non-foaming urethane was introduced in 1998.
- Synthetic tie plugging extends life of Ties & Rail.
Product

- Synthetic Plugging Materials
- Test Data
Delivery Systems

- Synthetic Applicator Types
- Productivity
CN Practice

- Where
- How
- Results
Conclusion

- What have we learned?
Synthetic Plugging Materials

- Currently two types of products are offered in the industry
  - Solid Non Foaming Urethane
  - Foaming Urethane

- There are advantages to both types of products
  - Solid Non Foaming Urethane
    ★ Yields the highest results in most extraction and load tests due to high density.
  - Foaming Urethane
    ★ Foaming makes room for spike to sit into spike hole
    ★ More coverage due to the foam expansion.
Solid Urethane High Density Products

- Solid Non-Foaming Urethane Tie Plugging product
- Two component urethane 2:1 ratio by volume using a static mixing system.
- Solid Non-foaming urethane with superior performance in the area of gauge holding lateral cyclic movement
- Very good results in high degree, high tonnage, high speed curves as material is similar in density to a Hard Wood Tie and works in all weather conditions.
- Currently being sold to all Railroads.
Foaming Urethanes

- There are two types of Foaming Urethanes available.
  - Low density foaming urethane
  - High density foaming urethane
Low Density Foam Urethane

- Two part urethane tie plugging adhesive.
- Low density foaming product, 35lb in a dry or wet hole.
- Dynamic mix system required with 1:1 mix ratio by volume.
- Excellent wet hold performance
- Currently selling and approved for use by most major railroads.
High Density Foam Product

- Two part urethane tie plugging adhesive
- High density
  - 62lb in dry hole, 55lb in a wet hole
- Static mix system required with 1:1 mix ratio by volume.
  - Slightly foaming product allows for internal cells to collapse when a spike is driven in preventing bent spikes and tie splits
- Currently sold and approved at Class I railroads
Testing

- TTCI – Insertion
- TTCI – Extraction
- Bodycote Cyclic Load Testing
- Bodycote Material Testing
TTCI Test Information - Insertion Forces (lbs.)

- New Wood Untreat.
- Used Wood Untreat.
- Used Wood Square Plug
- HTT
- R-Sol
- R-Sol Wet
- WVC

Legend:
- Low
- High
- Average

Notes:
1. Vacated Spike Hole - not spike-kill simulation (TD97-003)
2. Hand-operated gun application
3. Pneumatic portable gun application
4. On-track machine application
TTCI Test Information - Extraction Forces (lbs.)

![Extraction Force Graph]

- **Low**
- **High**
- **Average**

1. Vacated Spike Hole - not spike-kill simulation (TD97-003)
2. Pneumatic portable gun application
3. Hand-operated gun application
4. On-track machine application
Bodycote Cyclic Load Testing:

- Light Density Foam Urethane showed very strong results
  - Very little fatigue seen after 3 million cycle test
  - At 20,000 lbs, deflection was very low. Well below the desirable deflection of 0.5”.
  - The same test with cedar plugs yield 0.532” of gage widening!
Test Results

- Both the Solid Urethane & Foaming Urethane showed very strong results out performing wood tie plugs in each test.

- At CN we currently use both the Solid Non Foaming Urethane & the Foaming Urethane all with great results.

- In the area that I manage which is Western Canada we are currently using only the Solid Non Foaming Urethane so this is where most of my experience is.
Synthetic Applicators

- Handheld Canister System
- Intermediate Dispensing System
- Dual Dispensing System
- High Production System
Productivity of Synthetic Applicators

- Handheld canisters can fill approximately 5 to 10 ties per minute.
- Intermediate dispensing systems will fill approximately 10 to 15 ties per minute.
- Medium sized systems or Dual dispensing systems are capable of 15 to 20 ties per minute.
- Large systems are capable of 25+ ties per minute.
Handheld Canister Applicators

- 450ml Canisters
- Manual applicator (left)
- Cordless applicator (right) is able to dispense 60+ canisters on one full battery charge
- The cordless applicator can dispense a canister in 45 seconds @ 60°F
- Fifteen to eighteen cut spike holes filled per canister
- The productivity of canister is less than five minutes
Handheld Canister Applicator
This Single Dispensing System is capable of filling approximately 750 ties with three holes per tie, without adding chemical. This system can fill approximately ten plus ties per minute.
Dual Dispensing System

- This Sperling chassis, built for CSXT, works with the rail out of place by utilizing a crawler system.
- Capable of filling 15 to 20 ties a minute utilizing two dispensing valves.
This system, currently in use by CN, works with rail in place, filling spike holes through the tie plates.

This system is capable of filling 15 to 20 ties per minute utilizing two dispensing valves.
Dual Dispensing Systems – For Curve Gangs

- High Output Walk behind Tie Plugging Machine.
- Two dispensing guns allow two operators to fill spike holes simultaneously.
- This system is capable of plugging 35 ties per minute.
High Production Systems

High Production Single Sided Rail Gang
- Requires two self-propelled, machines are equipped with two dispensing guns for up to four operators filling holes simultaneously. This configuration is capable of plugging up to 40 ties per minute, per machine.

High Production Dual Side Rail Gang
- Requires four self-propelled machines are equipped with two dispensing guns capable for up to eight operators filling holes simultaneously. This configuration is capable of plugging 40 ties per minute, per machine.
High Production Systems Chassis

- Utilizes industrial crawlers and two 200 gallon reusable chemical totes.
- Capable of filling 25 to 35 ties a minute, while filling approximately 3 miles of single side track without adding chemical.
This system, built for CSXT, uses industrial crawlers and has two 200 gallon reusable chemical totes.

This chassis is capable of filling 28 to 35 ties per minutes and can fill approximately three miles of single side track without adding chemical.
Material Transfer

- Chemical transfer made easy with reusable totes, eliminates expensive container disposal fees. The Nordco and CSXT / Sperling chassis utilize these returnable totes. The totes provides a safe, proficient and clean working environment, with minimal chemical contact for the employees.
CN Practice

- Switch Ties
  - Gauge 80 of 400 t/o’s per year 20%
  - Deferral of Capital Switch Tie Replacement
  - Protection of major components
    - Switch points
    - Stock Rails
    - Frogs
CN Practice

- Bridge Deck Ties
  - Synthetic Tie Plugging used when gauging all decks.
  - 100 decks high tonnage, high curvature
  - Defer capital purchase of deck ties
Background on Rail Replacement

This year at CN,

220 Track Miles of New Rail = $75 Million

99 Track Miles of PW Rail = $15 Million
CN Practice

- Rail replacement
  - 22 miles on wood ties 100% Synthetic tie plugged in 2003
  - Protect Major Investment
  - Gauge Less than ½” wide reduces rail wear
  - Defers Tie Replacement
Background on Tie Replacement

- 13.24 million ties will be purchased by class 1’s in 2003.
  - BNSF – 1.93 million
  - CPR – 770,000 (CPR representative)
  - CNR – 950,000
  - CSX – 2.76 million
  - KCS – 250,000
  - NS – 2.58 million
  - UPR – 4 million

- Tie maintenance and replacement represents major portion of overall expenditures.

Source: March Issue of Progressive Railroading 2003 MOW Plans: Class 1s
CN Practice

- Gauging
  - 100% of our Gauging is done with Synthetic Tie Plugging
  - This Year 34 miles of 2,600 main track miles in Western Canada
  - 2004 Plan is 47 miles
  - Increasing each year
  - Extends Tie Life
  - Extends Rail Life
  - Reduces Down Ties with Surfacing
CN Practice

- In Track Joint Elimination
  - 100% Synthetic Tie Plugged
  - Reduces need to replace joint ties.
  - Strengthens track
CN Practice

- Heavy Axle Loading
  - Low tonnage lines raising from 263,000 lbs to 286,000
CN Practice

- Speed Increases
  - Increase from Class 4 to Class 5
Industry Perspective Comments

- **Wood plugs**
  - Allow water, air, rot and dirt into the spike hole area. Even a small amount results in degradation of the spike holding capacity.
  - Do not encompass or fill the entire void.
  - More prone to rot.

- **Compounds**
  - Fill the void completely making the 4 problems mentioned above a non issue

- **Advantages of Synthetic Plugging vs. Wood Plugs**
  - Material handling
  - Improved ergonomics

- Holds spikes as well as or better than original wood fiber.
  - Using synthetic compounds are proven, by our own test procedures, that they strengthen the tie spike holding. In addition, they provide a better seal against moisture. On CSX where synthetic compounds have been used the track strength (gage holding) is measurably improved.

- **BNSF** – Currently Plugging & respiking ahead of tie gangs.

- **TTCI** – Currently running test on Fast Track.
Summary

- High tonnage / Low tonnage
- Curves / Tangents
- Turnouts – Main & Yard Tracks
- Bridge Decks
- Rail Replacement
- Gauging
- Heavy Axle Loading
- Speed Increases
Summary

- Our goal is to add Synthetic Tie Plugging every time we remove a track spike or lag screw.
- Improving Track Quality
- Deferring Capital Replacement
- Extending Component Life
- Maximize Capital / Operating $
Based on our experience at CN and the information we have gathered from other railways, Synthetic Tie Plugging is a cost effective method of extending the life of a number of expensive track components. Savings generated through deferred and reduced replacement and derailment prevention are keeping expenses down and traffic moving.

Over the last 5 years at CN we have expanded our use of synthetic tie plugging. We plan to continue this trend. We feel we are getting excellent benefit from our investment in Synthetic Tie Plugging.
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Questions?
Final Comments