2019 Award Nomination

Title of Innovation:
ROCKWOOL WR-TECH™

Nominee(s)
Osama Hamza, ROCKWOOL Technical Insulation

Category:
Materials Design

Coatings and Linings	Instrumentation
Cathodic Protection	Testing
Materials Design	Integrity Assessment
Chemical Treatment	Other—fill in

Dates of Innovation Development:
(from [October, 2012] to [October, 2017])

Web site:
http://www.rockwool-rti.com/en/industrial/wr-tech/
https://youtu.be/nCRd7a0JRGk

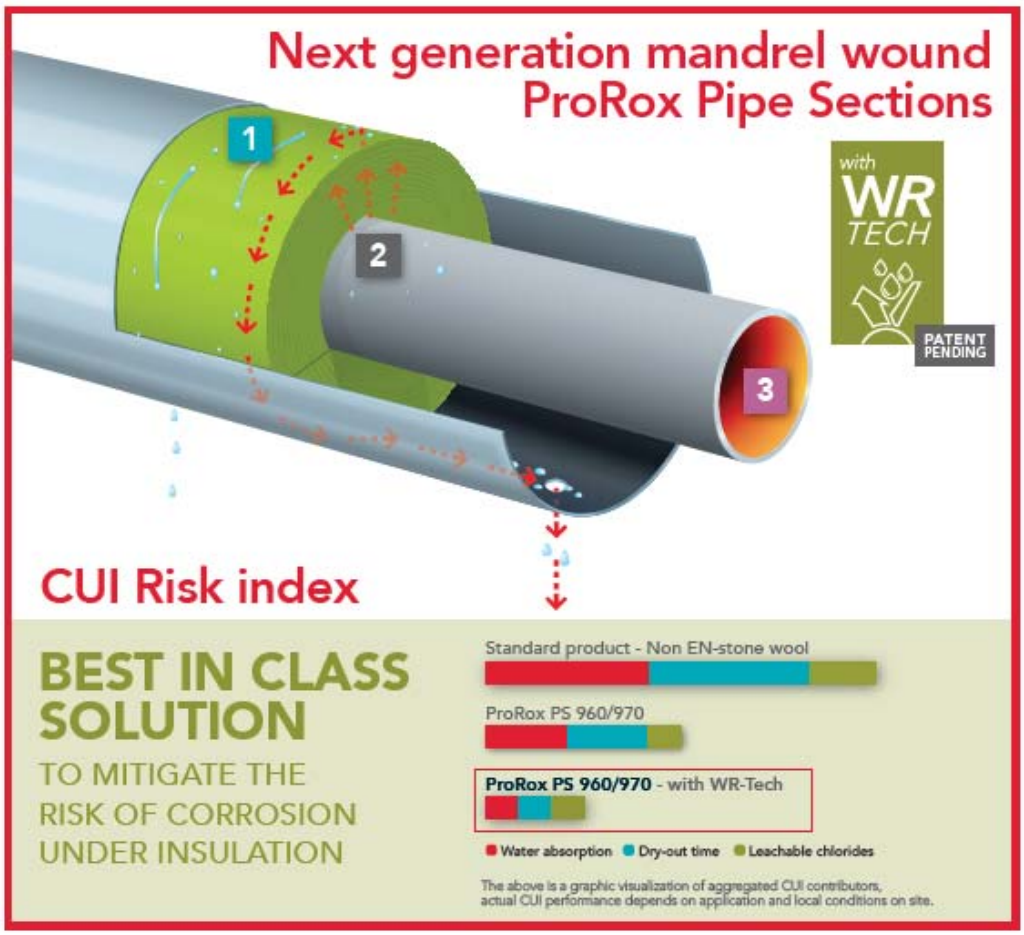
Summary Description:
ROCKWOOL™ has developed the next generation of our ProRox® mandrel wound stone wool pipe sections that incorporates a ground-breaking, innovative, hydrophobic additive called WR-Tech™, "Water Repellency Technology." WR-Tech pipe sections are the best-in-class solution to mitigate the risk of Corrosion Under Insulation (CUI), resulting in lower total costs of ownership and increased on-site safety. WR-Tech pipe sections have five-times less water absorption (lower than 0.2 kg/m2) than the best available standard on the market, fast water dissipation (quickly dries), durability over the entire CUI temperature range, and < 10 ppm leachable substances.


Combat the risk of
Corrosion Under Insulation
with
WR
TECH
Don't let water take
hold of your pipes

Full Description:

1. What is the innovation?

WR-Tech is the first effective way to deal with Corrosion Under Insulation (CUI) implemented in an open-cell insulation product by maintaining hydrophobicity within the CUI temperature range.



1. Water Absorption: 5x lower absorption than best available standard EN 13472, minimizing water absorption and maximizing water flow away from the insulation material.

2. Fast Drying: The vapor open structure ensures that water can evaporate freely in the event it reaches the pipe surface. The low water absorption ensures the fastest dry-out time.
3. Durability: Fully-durable water repellency performance up to 250°C (482°F) over the whole CUI temperature range.

2. How does the innovation work?

The National Association of Corrosion Engineers (NACE) states, *"Because CUI is a product of wet metal exposure duration, the insulation system that holds the least amount of water and dries most quickly should result in the least amount of corrosion damage to equipment."* NACE SP0198-2016 (2.1.2)

Water repellency of mineral wool is obtained via a combination of the binder used in the mineral wool and water repellency additives. The efficiency and durability of the repellency depends on the distribution, type, and amount of the additive.

Water repellency additives work by changing the surface tension of the mineral wool fibers, thereby making it more difficult for the fibers to get wet, which delays the penetration of water into the mineral wool.

WR-Tech is a proprietary additive based on an inorganic resin that is introduced into ROCKWOOL's mineral wool early in the production process. The timing of the additive placement allows it to coat each individual fiber of the insulation material, resulting in a more uniform distribution. This homogenous distribution allows for maximum water repellency performance after the product is cut and installed.

The additive is stable at higher temperatures and allows mineral wool to effectively retain hydrophobicity within the critical CUI temperature range of 50 °C (122 °F) – 175 °C (347 °F) and is durable up to 250°C (482°F). By improving the water repellency, less water is expected to be in contact with the base piping for shorter durations, ultimately allowing for decreased corrosion damage.

3. Describe the corrosion problem or technological gap that sparked the development of the innovation? How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap?

CUI is a key challenge for many of our partners within industry because it occurs under all types of insulation, leads to high maintenance costs, and can cause pipe leaks or even ruptures. CUI is expensive, and accounts for an estimated 10 percent of overall maintenance costs and 40-60 percent of pipeline maintenance costs in the oil and gas industry. It is a problem that plagues aging industrial facilities as they require additional maintenance.

ROCKWOOL's WR-Tech mitigates the risk of CUI for pipes, resulting in increased longevity and lower maintenance costs. Also, less corrosion leads to fewer leaks and piping failures. The additive can reduce the absorption of water by up to 5 times (lower than 0.2 kg/m2) less than the best available standard, dry faster, are more durable and have a very low water–leachable salt content.

There are three main types of additives used to obtain water repellency of mineral wool:

1. **Mineral oil-based additives** are the most frequently used, due to cost, and at the same time, are used for dust suppression in the production process of the mineral wool. Most mineral wool used globally is installed inside of dry buildings, where water repellency is needed only to ensure that the insulation is dry at the time of installation. However, the mineral oil additive is vulnerable to oxidation at high temperatures. High temperature gradients may also cause migration (the oil moves around). Longer-term warm water exposure can wash out the oil. Loss of water repellency is typically seen at temperatures above 150°C (302°F).
2. Approximately 20 years ago, and as part of their CUI mitigation strategy, a large oil and gas owner asked the mineral wool industry in the UK to upgrade the thermal stability of the water repellency properties of the insulation supplied to their oil and gas facilities. This is where **silicone oil based additives** were introduced. The silicone oil increased the temperature resistance of the water repellency properties to >250°C (482°F). However, silicone oils can cause surface defects in high quality coatings, such as voids or separation, and therefore the use of insulation with silicone oils is restricted in many industries. This restriction prevented a wider use of silicone oil as an additive.
3. **Inorganic resin additives** are a more recent development in water repellency of mineral wool. They provide the benefits of silicone oil with heat stability but are not mobile and do not affect coating operations. Overall, inorganic resins are the superior additive for water repellency and they are silicone oil free.

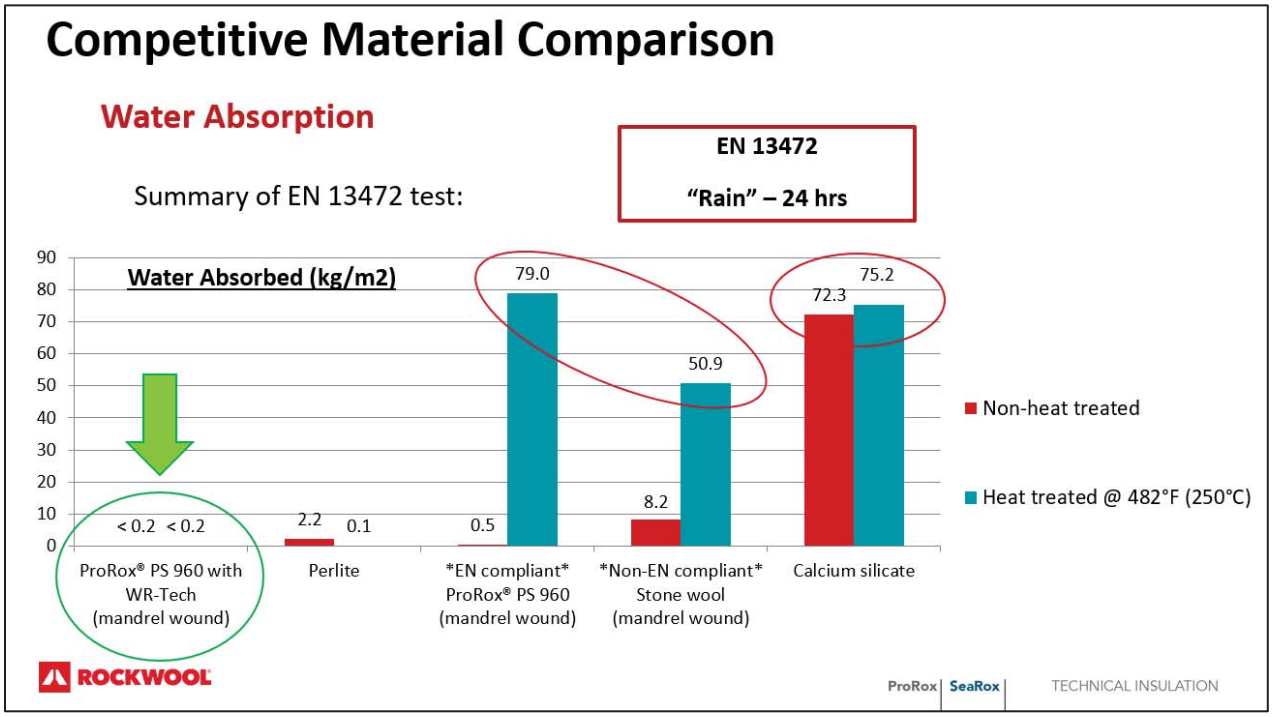
WR-Tech puts mineral wool truly in a “class of its own.” It pushes the frontier of open-cell insulation and CUI mitigation, by being the first open-cell, water repellent insulation on the market.

At present, ROCKWOOL’s patent-pending WR-Tech is the only open-cell insulation utilizing an inorganic resin additive for water repellency. Other mineral wool competitors have not been able to maintain water repellency at high temperatures. That makes this technology truly innovative.

4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

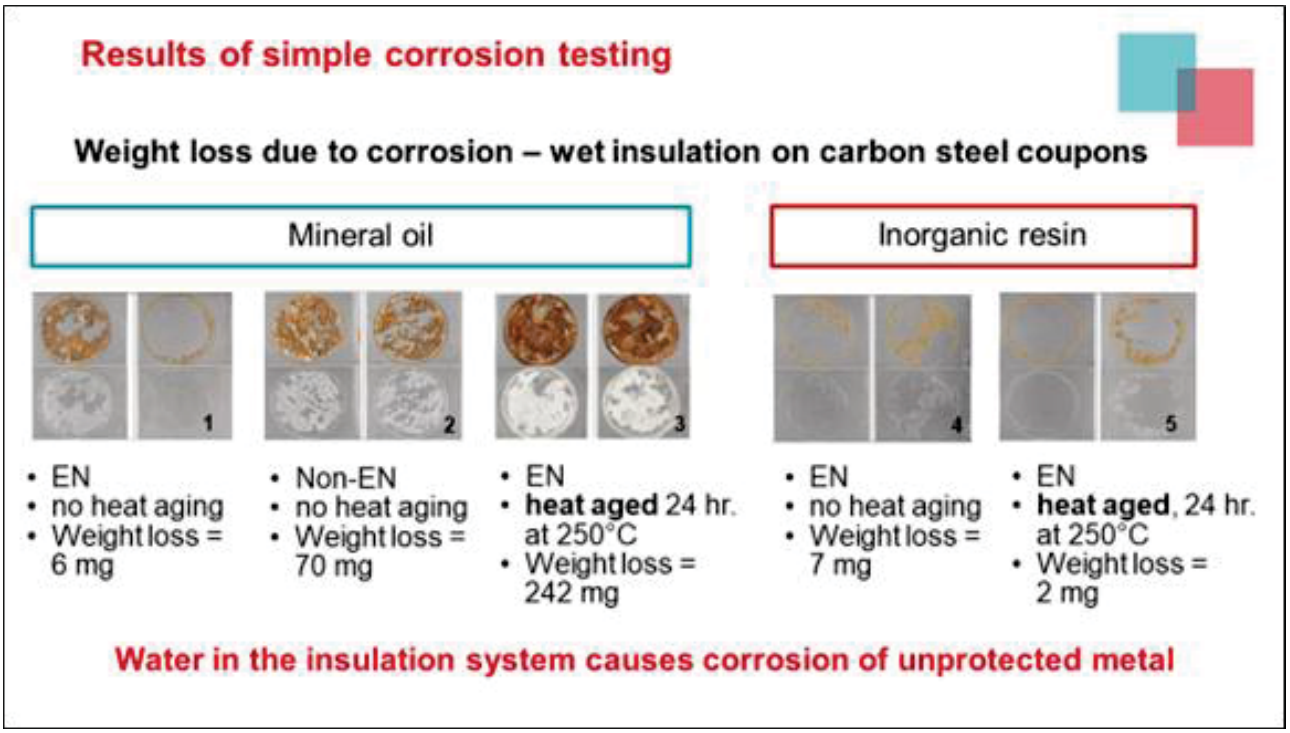
WR-Tech has been tested for water absorption according to EN 13472 by a third-party testing laboratory. The EN 13472 test is the determination of short-term water absorption by partial immersion of preformed pipe insulation. In other words, it simulates the water absorption caused by exposure to rain during product installation.

The chart below compares results of water absorption performance across different types of insulation before and after heat treatment to 250°C (482°F). Even after heat aging at 250°C for 24 hours, the water absorbed by ProRox® PS 960 with WR-Tech was only < 0.2 kg/m^2, compared to 79 kg/m^2 without the WR-Tech.



In this test, you can see that mineral wool with an inorganic resin additive (WR-Tech) **absorbed significantly less water** when compared to mineral wools with a mineral oil additive. It also, had **on-par performance with perlite**, which is considered the "gold standard" for water absorption in the insulation industry.

To demonstrate the effects of WR-Tech on the water absorption properties and corrosion rate, a simple test method was constructed, consisting of a water exposure phase aiming at saturating the mineral wool samples, followed by an exposure period, where the wet insulation was positioned on carbon steel test coupons. Insulation samples are partially immersed in demineralized water for seven days, the coupons were placed on a hot plate at approximately 50 °C (122 °F), and corrosion was measured as weight loss. The results are shown below.



The EN compliant material is an insulation product with a water absorption declaration of < 1 kg/m2, the non-EN is an insulation product with no declaration in relation to water absorption.

As expected, the mineral wool with the highest amount of absorbed water was sample 3, the heat-aged mineral oil treated material. This sample also kept the steel surface wet for the longest period, and therefore also exhibited more corrosion on the test coupons.

The insulation with the **inorganic resin** (WR-Tech) gave the **lowest amount of corrosion** both for non-heated and heat-aged samples.

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

This innovation is incorporated into ROCKWOOL's mineral wool mandrel wound pipe sections. Mineral wool insulation is a frequently specified insulation material for high-temperature applications in common industrial facilities, such as refineries, petrochemical plants, and power plants. Since mineral wool is already used by the industrial market, incorporating this water repellent technology makes the adoption/use of the product seamless, as there are no changes to product handling, storage, or installation. Additionally, although significant investments were made into research, development, implementation, and marketing, no material price increases were passed along to the customers for this innovative technology.

WR-Tech is another tool to help in the battle against CUI and will work in concert with existing corrosion prevention controls such as coatings, inspections monitoring systems, etc. The benefit of using ROCKWOOL's ProRox stone wool mandrel wound pipe sections with WR-Tech is reduced corrosion, which will help to extend the service life of piping, lower maintenance costs, and decrease possibilities of pipe leaks and failures.

6. Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

ProRox stone wool mandrel wound pipe sections with WR-Tech have been commercially available since the fourth quarter of 2017. The challenges are in education and awareness, and monitoring/measuring real world data. These challenges can be overcome with widespread dissemination of information, publication of technical findings, and engaging owners and customers for feedback, that will allow us to monitor and measure results to provide further proof of success.

In terms of educating the industry our mandrel wound pipe sections with WR-Tech are changing the technical landscape and industry perception of open-cell insulation materials and water absorption. The current perception is that open-cell materials absorb water and are at a higher risk of CUI. This historical perception was correct, as there were no equivalent water absorption standards in North America for ASTM C547 mineral wool. This is why ROCKWOOL refers to the EN 13472 standard, which aims to reflect real life situations for water absorption. ROCKWOOL's ProRox mandrel wound pipe sections with WR-Tech have bridged the CUI gap not only for mineral wool materials, but for open-cell insulation materials.

7. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

Patent application numbers:

1. PCT/EP2018/073273
2. PCT/EP2018/073268

Title: "USE OF A MINERAL WOOL PRODUCT".

Inventor: Claudia Zwaag (ROCKWOOL Technical Insulation)

References:

1. NACE SP0198-2016, "Control of Corrosion Under Thermal Insulation and Fireproofing Materials – A Systematic Approach. NACE International.
2. C. Zwaag and S.N. Rasmussen, "Mineral Wool and Water Repellency" NACE CORROSION 2018, paper no. 10929