LESS-TOXIC MARINE FENDERS
When energy from waves pushes boats up against docks, jetties, and other vessels, ship and marina owners install fenders to vessel hulls and docks to absorb the energy and prevent damage. Used tires are a popular choice for fenders; they are cheap and abundant and shipyards have used them for decades.

RUBBER TIRES IN MARINE ENVIRONMENTS
Although repurposing used tires keeps them out of landfills, chemicals leaching from tires—like zinc and organic hydrocarbons—can actually be toxic to aquatic animals. Juvenile fish are particularly vulnerable; chemical toxicity can cause them to lose equilibrium and have difficulty swimming or die.

Despite their widespread use, recycled tires don’t actually perform that well as marine fenders. Tire rubber was designed for cars, and isn’t very effective at absorbing energy in marine conditions. UV exposure breaks tires down, and the cold seawater diminishes their elasticity and ability to absorb shock. And most boat owners aren’t exactly thrilled about the black streaks across their vessel hulls caused by rubbing against tires on docks and pilings.

CREATE A LESS-TOXIC ALTERNATIVE FENDER
Duwamish River ship operators approached entrepreneur Andries Breedt to design a marine fender that functioned better than repurposed tires. Breedt designed a new fender using EPDM513, a zinc-free rubber material. Unlike traditional rubber, EPDM513 is highly resistant to seawater, sunlight, and oxidation. It also meets the criteria under Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), a European Union regulation for chemical substances. An Italian chemist formulated EPDM513 for a German business owner who needed a new material to cover underwater cables running across the bottom of the North Sea.

TESTING FOR TOXICOLOGICAL EFFECTS
Breedt contracted Northwest Green Chemistry (NGC) to review the formula for EPDM513 and determine if it raised any initial aquatic toxicity concerns. Since EPDM513’s formulation is so different compared to the formulation for tire rubber, NGC proposed a “fail-fast” approach to testing. A fail-fast approach is a great way to screen for initial toxicological concerns without a significant capital investment. NGC partnered with Washington State University (WSU) to see if the new rubber substitute had the same acute toxicological effects on fish as tire rubber.

Lab researchers at WSU’s Puyallup research center exposed juvenile salmon to submerged blocks of EPDM513 and equally large chunks of used tire. The study concluded that fish exposed to EPDM513 showed no signs of toxic exposure, and all of the fish survived the study period. In contrast, nearly all (97%) of the fish exposed to the tire died within the 96-hour study period.
While the initial testing doesn’t address all potential chemical hazards present across the product’s life cycle, the experimental EPDM was non-lethal to a sensitive native species during acute toxicity tests.

It is clear that replacing used tires with EPDM would result in a vast reduction of immediate toxic risk to aquatic animals. Further testing is necessary to ensure that the product is still a less toxic alternative throughout the product’s life cycle.

**PERFORMANCE TESTING**
Breedt tested a fender’s performance at Fisherman’s Terminal in Seattle. He fitted one of the fenders around a piling next to the F/V Polar Lady, the 40-meter crabbing vessel featured on the first season of Discovery Channel’s Deadliest Catch.

Despite rough conditions at the marina, the fender performed exactly how Breedt expected it to, keeping Polar Lady safely separated from the piling. The port facilities manager reported that the single fender floated along with the boat, rising and falling with the tide. In contrast, tires can’t rise and fall with the tides, so often pilings must be fitted with several tires to provide protection throughout tide cycles.

**WHAT’S NEXT?**
To demonstrate how his fender absorbs energy, Breedt created a simulation machine he calls Waterbok. Waterbok is equipped with a load sensor that registers how much force vessels exert onto structures, and how the fender dissipates that force. Breedt is setting up Waterbok as a display at the 2016 Hannover Messe, so attendees can see the fenders in action.

Breedt hopes to begin manufacturing and selling his fenders here in Washington State by the end of 2016.