

OHRIGINS, AN ENGINE FOR THE BIOECONOMY

How CENER's technology turns black liquor into high-performance antioxidants

Industrial antioxidants protect the products we rely on every day. They prevent oxidation and degradation in fuels and lubricants, help polymers and elastomers keep their mechanical properties and they support stability in sensitive formulations such as those used in cosmetics and food related applications.

Yet most antioxidants used today are still fossil based. That raises environmental concerns as producing these additives typically involves energy intensive chemical manufacturing and associated greenhouse gas emissions. As tighter environmental rules and regulations are implemented and customers increasingly scrutinise supply chains, the need for alternatives becomes stronger.

At the same time, research and industrial innovation are changing how we look at biomass. By-products that were once treated as the end of the cycle, or simply as low value streams, are increasingly seen as resources that can be upgraded into higher value products.

This is where ZEBRA-LIFE originates. The project has built a pilot plant designed to transform black liquor into renewable antioxidant additives. And behind it all sits OHRIGINS.



WHAT IS OHRIGINS?

OHRIGINS is a depolymerisation technology developed by CENER, coordinator of the project. It is designed to produce high-performance, bio-based antioxidant additives.

But the key about OHRIGINS isn't only that. The technology was developed specifically to cover two main needs: scalability and integration. Let us walk you through it.

WHAT DOES OHRIGINS PRODUCE?

OHRIGINS is specifically designed to upgrade Kraft lignin derived from black liquor into high-performance, bio-based antioxidant additives. It converts Kraft lignin into specification-ready antioxidant fractions targeted at demanding applications.

Pilot production has delivered consistent batches, which is essential for companies that need repeatable quality before they can test an additive in real formulations.

HOW DOES IT WORK?

Lignin is a complex natural polymer that tends to behave in two opposing ways during processing: you can break it down, but it also has a natural tendency to re-condense (re-form larger, less useful structures). OHRIGINS is designed to steer that balance in the right direction.

The technology uses controlled oxidative depolymerization to overcome this challenge. At the molecular level, it breaks ether bonds and limits the natural tendency of lignin fragments to re-condense. At the same time, it enhances phenolic fractions, which are associated with antioxidant activity.

The process targets low molecular weight phenolic fractions in the range of 300 to 600 Da, with low polydispersity. This produces a narrower distribution of molecules, supporting more uniform behaviour as an additive.

REMOVAL OF SULPHUR

A defining feature of OHRIGINS is the removal of sulphur during processing, delivering a final product that is sulphur-free. This matters because Kraft lignin contains sulphur from kraft pulping chemistry, and this can be a limitation for applications with strict purity and odour requirements, such as cosmetics and food related uses.

INDUSTRIAL INTEGRATION

OHRIGINS was developed to fit conventional pulp mills. It is engineered from the start to fit smoothly and uses reagents that are already familiar to the

sector. That matters because lignin valorisation only becomes useful at scale if it can be integrated without disrupting how a mill runs.

The pilot plant itself follows the same logic. The depolymerisation reactor and the purification train operate in continuous mode, which helps deliver stable product quality and gives more realistic information for scale up. The system is built using standard materials and unit operations, and it is designed to respect the inorganic balance that kraft mills rely on.

To reduce environmental impact and chemical consumption, the process also includes recovery and closed-loop handling of side streams. In practical terms, the aim is to produce renewable antioxidants in a way that can be adopted by existing industrial infrastructure and operated reliably at semi-industrial scale. This is what scalability and integration look like in practice.