SUSTAINABILITY IN BORREGAARD

Borregaard operates one of the world's most advanced and sustainable biorefineries. By using natural, renewable raw materials, we produce advanced and environmentally friendly biochemicals that can replace oil-based products.

Our sustainable products and solutions can play an important role in addressing some of the world's greatest challenges: Population growth and climate change. High utilisation of renewable raw materials, and products that replace oil-based alternatives result in low carbon footprints and make Borregaard a sustainable and innovative company with solutions the world needs.

REDUCED CARBON FOOTPRINTS

Borregaard's lignin biopolymers are biobased and produced from sustainably managed forests.
Life cycle analysis (LCA) conducted by a third party shows that Borregaard's lignin biopolymers absorb more CO_2 than they emit during their manufacture, giving a very favorable carbon footprint (Figure 1).
Thus,Lignin biopolymers present a sustainable alternative to polycarboxylates in automatic dishwasher (ADW) detergent formulations.

ANTI-FILMING ADDITIVES - A SUSTAINABLE ALTERNATIVE

Dishwasher film is a white deposit that can build up on tableware over repeated washes with hard water and is particularly problematic in carbonate-based formulations such as tablets and powders. Synthetic polycarboxylates, such as polyacrylate, are typically used in ADW detergent formulations to reduce film. However, synthetic polymers are usually produced from oil-based chemicals or from highly refined agricultural raw materials (e.g. sugars) using processes that have a large carbon footprint.

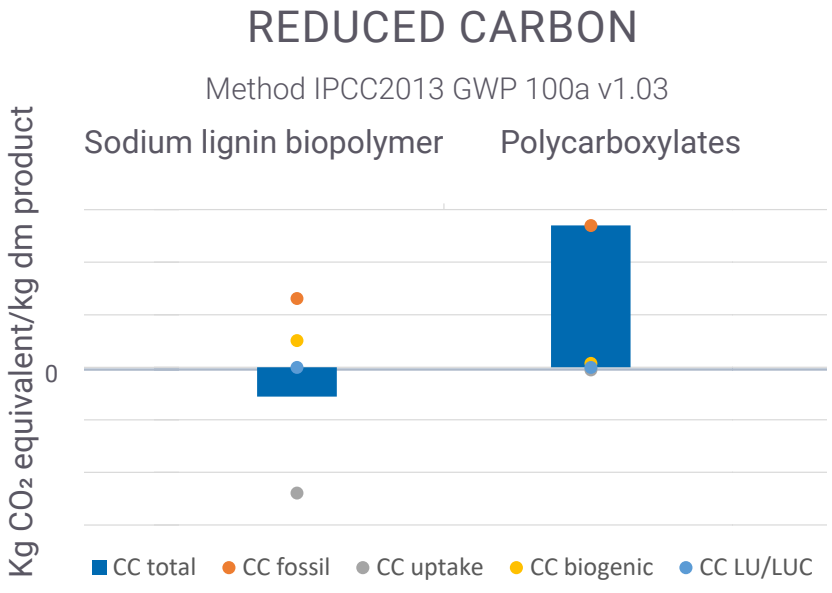

Figure 1: Data from LCA analysis comparing environmental metrics of a lignin biopolymer to a synthetic polycarboxylate. CC total (blue bars) shows the total CO_2 emissions and coloured markers show individual contributions. Lignin contains more absorbed carbon (CC uptake) than the carbon released during lignin biopolymer manufacture, resulting in a negative total emission value. Calculations based on 'cradle-to-gate' do not include products' end of life.

PROOF OF CONCEPT

A lignin biopolymer from Borregaard was tested for anti-filming properties in a carbonate-based ADW detergent formulation (Table 1). This formulation is typical for a powder or a tablet and uses a polyacrylate anti-filming agent. Anti-filming tests were carried out according to ASTM D3556-14, where filming was measured on glass and ceramic after 10 consecutive washes in a Miele GSL-2 (50°C 3' / 8' / 55' program 3), with water hardness 350ppm (Ca:Mg 2:1).

The standard Soil Ballast Load (recipe from IKW) was used, which is a mix of starch, protein and fat.Following the wash, the glass and ceramic tableware were inspected and photographed in a black box lit from below to emphasise the spots and film. The photographs are shown in Figure 2. Both biopolymer and polyacrylate were effective at reducing film on the glassware and ceramic tile, with a slightly better performance from the biopolymer.

INGREDIENT	DOSAGE
Sodium carbonate, anhydrous	20-32% (balancing)
Sodium citrate dihydrate	30%
Sodium silicate	25%
Anti-filming agent	6%
Sodium perborate monohydrate (5%)	8%
TAED	2%
Linear fatty alcohol ethoxylate	2%
Protease Savinase	0,25%
Amylase Termamyl	0,25%

Table 1: Dishwasher detergent formulation used to test anti-filming properties of lignin biopolymer versus polyacrylate.

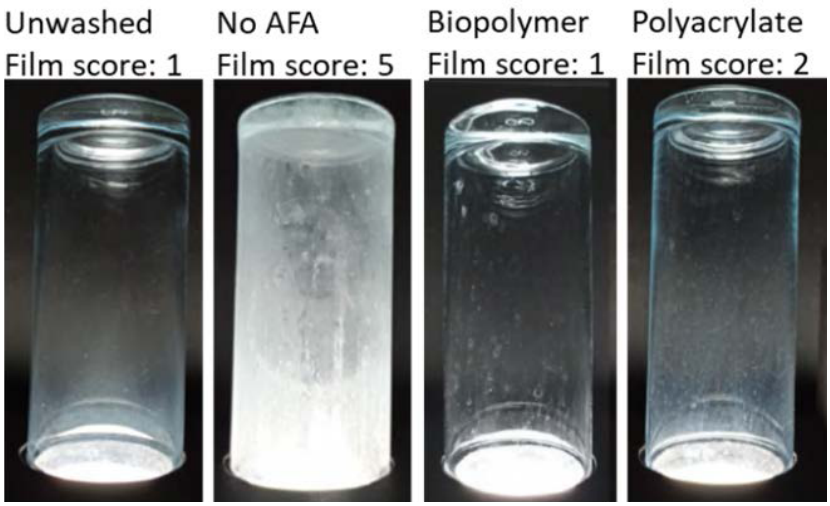

Figure 2: Standard drinking glasses after repeated wash cycles using detergent formulation in Table 1 without anti-filming agent (AFA), or with 6% biopolymer or polyacrylate.

BORREGAARD PRODUCTS IN ADW FORMULATIONS

Borregaard lignin biopolymers are high-performing cost-effective alternatives to synthetic polycarboxylate anti-filming agents for ADW detergents. The results show that the lignin biopolymer gave similar or better anti-filming performance than the polyacrylate in the carbonate-based ADW powder test formulation. Borregaard's lignin biopolymers can increase performance and significantly reduce the carbon footprint of ADW detergents.