International

Solutions for biofuel cargos

The future of linings requires the expertise of experience and the innovation of tomorrow

AkzoNobel

Protection through expertise and innovation

Environmental social governance (ESG) is a growing focus in the energy sector today and will determine the future of the industry, driving new innovations and materials to be used to meet increasing regulations and targets. From cleaner burning energy sources to more sustainably derived feedstocks, a new generation of cargos are emerging into the market.

The industry is fast moving from a situation of one feedstock source with limited variation and a thorough understanding of the risk to a rapidly changing situation with multiple new feedstocks. These new feedstocks have differing compositional parameters, differing physical/chemical properties and a biological source presents issues that are not typically encountered with the fossil-based analogues. Renewable feedstocks differ for fossil based in some key areas, all of which can impact the corrosive nature of these materials

- Higher hygroscopicity
- Higher electrical conductivity
- Higher polarity
- Higher solvency
- Higher oxygen content

With new innovations and cargos, comes the need for new solutions to fight corrosion and protect cargos from impurities. You need long-term coatings and linings solutions that won't have a long-term impact on your current production or budget.

Biofuel feedstocks and finished products are dynamic, even in storage.

In contrast to the fossil energy economy, which is based on a small number of different feedstocks that are generically similar with well understood extraction, refining and utilization technologies, the newer low carbon technologies often have a larger range of feedstocks which present different issues.

These biofuels have different storage requirements than traditional legacy cargos. Animal or vegetable fats, oil and derivatives usually contain a certain amount of free fatty acids (FFA). At elevated temperatures or in the presence of water, the formation of FFA is accelerated, especially when the initial concentration of FFA is high. These high concentrations of FFAs can have an accelerating effect on corrosion and lining breakdown.

Bioalcohol cargos such as biomethanols and bioethanols are required to maintain extreme purity for appropriate processing and to reduce the corrosiveness of the cargo on steel. Ensuring your linings protect the purity of your cargo while fighting any corrosion on your asset is key to bioalcohol protection.

New bio-based feedstocks and cargos require new consideration for linings protection

Biofuel categories

From an infrastructure perspective renewable fuels can broadly be divided into the 3 categories of animal or vegetable oils/acids feedstock, refined biofuels and bioalcohols. Each of these has its own particular risk factors and risk mitigation including use of the correct protective coating.

Biofuel feedstocks

These feedstocks, predominantly animal and vegetable oils/acids and range from relatively pure vegetable oils such as corn and rapeseed to cruder cargoes such as crude palm oil or increasingly used cooking oil (UCO) and waste animal fats such as tallow. Whereas low viscosity oils can be stored at ambient or slightly above, cruder or more highly viscous cargoes can be stored at temperatures up to 80°C.

Accelerated corrosion rates for mild steel have been observed with these feedstocks often necessitating application of a protective coating. With the question being which coatings are suitable. From a coating perspective there are multiple possibilities but choosing the correct coating requires evaluation of some key parameters.

The Free Fatty Acid content (FFA) is key as increasing fatty acid content increase the aggressive nature of the cargo.

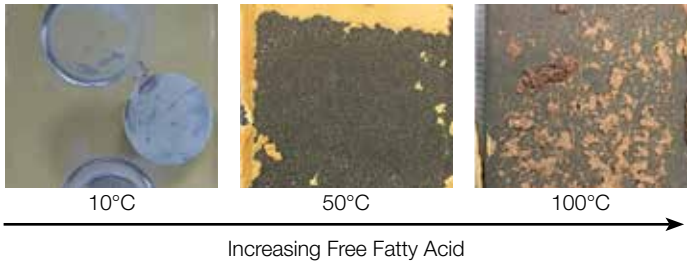


Fig 1: Impact of increasing fatty acid content on a generic epoxy coating at 60°C

Additionally, the higher the storage temperature the more aggressive the cargo becomes and a coating which is resistant at 60 or 70°C storage temperature may fail at 80°C

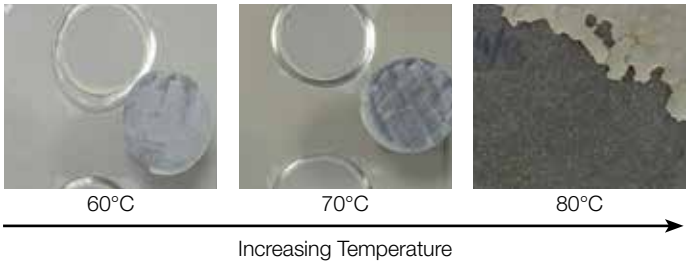


Fig 2: Impact of increasing temperature at 100% fatty acid content on a generic epoxy coating

Key parameters for feedstock coating selection

- Free Fatty Acid Content (Total Acid Number)
- Storage temperature
- Water content
- Mineral acid content

Rancidity changes feedstock composition

Unlike hydrocarbon feedstocks, the chemical composition of renewable diesel feedstocks can become increasingly aggressive over time, a process called rancidity. Chemically speaking this is the oxidation or hydrolysis of the fats and oils when exposed to air, light, moisture or bacterial action. It can increase the free fatty acid content or form aldehydes and ketones, all of which can increase the aggressive nature of the cargo.

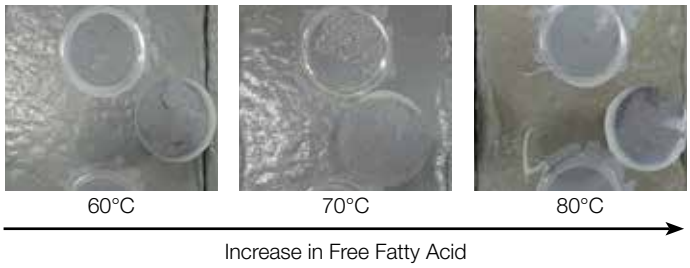


Fig 3: Impact of increasing fatty acid content on a vinyl ester coating at 80°C

Refined cargos

End products such as FAME (Fatty Acid Methyl Ester), HVO (Hydrogenated Vegetable Oil) or SAF (Sustainable Aviation Fuel) are more similar to their fossil-based analogues than the feedstock and present less of a challenge although their biological origin can leave them more susceptible to biological attack.

Bioalcohols

Bioalcohols such as Ethanol, Methanol or Butanol differ little from the hydrocarbon sourced versions and the issues and associated mitigation measures are well known. Although not directly aggressive to steel for instance Ethanol is known to facilitate stress corrosion cracking at high stress areas in tanks and application of a protective coating is advised.

Key parameters for Bioalcohol coating selection

- Storage temperature
- Water content
- Impurities

International's linings product range is world-renowned for its quality and reliability.

Moving through the process

In general terms storage conditions become less aggressive the higher the initial cargo purity and the further it moves through processing. At each step in the process the cargoes can present differing storage risk and a good understanding of each of these steps aid correct coating selection. These steps can be split into Raw Feed, Clean Feed, Finished Product and Auxiliary.

Our linings are developed to maximize performance for nearly every lining application in the field.

Developed through industry leading innovation and backed by over 40 years of real world experience. AkzoNobel lining solutions deliver operational flexibility and reliability to biofuel market stakeholders globally.

With over 100 years' experience in the heavy-duty lining business across multiple market segments and an unrivalled product portfolio, AkzoNobel has the experience and product solutions to support the Global Energy Transition. Renewable feedstocks and associated refined products may be relatively new to the downstream market but AkzoNobel has long been providing advice and lining solutions for these cargoes in other segments. This experience has enabled us to provide a range of proven solutions and ideally suited to the demands of a dynamic market.

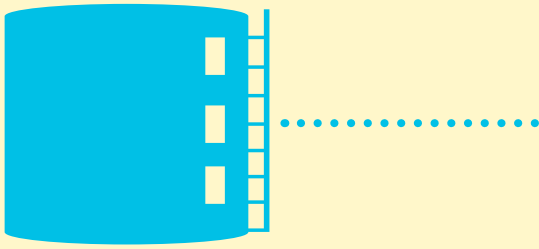
Biofuel storage can be dynamic in needs, temperatures, and chemical make up. from feedstocks to finish products, understanding the difficulties and nuances these various cargos have is critical in ensuring your tanks are lined properly. Corrosion and failure can happen quickly if the myriad of variables are not considered.

Free fatty acids (FFA) is just one aspect to consider in the corrosivity. varying by type, concentration, and temperature of storage, additional water content percentages and unique material needs are also essential to consider. With all this together the needs of your lining can become complicated quickly.

The experts at AkzoNobel understand the complexity of these cargos and are available to help.

Raw Feed

Biofuel feedstocks containing high FFA content and/or stored at elevated temperatures. These are the most variable and aggressive cargos.



Delivering enhanced operational flexibility

Biofuel feedstock

Coating system	Max Acid Value (TAN)	Max free fatty acid percentage	Max water content	Max mineral acid	Max storage temperature
Ceilcote 282HB	Unlimited	Unlimited	Unlimited	Unlimited	80°C
Ceilcote 232	Unlimited	Unlimited	Unlimited	Unlimited	80°C
Ceilcote 242HB	Unlimited	Unlimited	Unlimited	Unlimited	60°C
Interline 994	Unlimited	Unlimited	1% Vol	None	71°C
Enviroline 405HTR	137 mgKOH/g	50%	1% Vol	None	71°C
Enviroline 376F	27 mgKOH/g	10%	1% Vol	None	40°C
Interline 984	137 mgKOH/g	50%	1% Vol	None	50°C
Interline 850	27 mgKOH/g	10%	1% Vol	None	40°C

Refined Biofuels

Coating system	Fatty Acid Methyl Ester (FAME / Biodiesel)	Hydrogenated Vegetable Oil (HVO)	Sustainable Aviation Fuel (SAF / Biojet)
Interline 994	Yes	Yes	Yes
Enviroline 376F	Yes	Yes	Yes
Interline 984	Yes	Yes	Yes[1]
Interline 850	Yes	Yes	Yes[1]

[1]EI1541 certification

Bioalcohols

Coating system	Ethanol (max 4% water)	Methanol (max 100 ppm water)
Enviroline 376F	Yes[2]	No
Interline 984	Yes	No
Interline 850	Yes	Yes
Interline 994	Yes	No
Interzinc 22	Yes (unlimited water)	Yes (unlimited water)

[2]Standard grades only

Clean Feed

Less aggressive biofuel feedstock. Consideration is often placed on ensuring these cargos maintain high purity.

Finished Product

Includes a wide variety of needs, from materials with properties similar to crude based diesel and jet fuels, to materials with high FAME (Fatty Acid Methyl Ester) content.

Auxiliary

A range of tanks to support biofuel production and storage. Can include slop, treatment, chemicals, processing water and more.

Product systems focused on key situations

With multiple feedstocks and cargos that can differ chemically, their potential to change compositionally on storage added to other functional issues such as new or existing facility assets, ambient conditions, available equipment etc. correct coating selection can appear a daunting process. It is true that no one coating will be suitable for all situations yet there are often multiple options available to meet the needs of any specification.

Vinyl Ester solutions

Whatever your biofuel needs it is essential your chosen products offer corrosion protection and chemical resistance and are readily available to meet all application situations. The Ceilcote® range of vinyl ester coatings offers proven performance, broad spectrum resistance to a variety of chemicals and are available in a variety of different grades suitable for application in all situations.

With biofuel cargos subject to a wide variety of thermal and chemical compositions, the Ceilcote® range of products offers to most capable, versatile, and proven lining in both lab and field in the industry.

Epoxy Novolac, Epoxy Phenolic solutions

Providing cost effective and versatile solutions to the Biofuel market, International's Interline® and Enviroline® Epoxy Phenolic and Epoxy Novolac lining solutions deliver advanced solutions designed to offer high levels of corrosion protection against a wide range of chemicals stored at elevated temperatures.

With quick installation, rapid return to service along with extensive Biofuel testing International has solutions designed to ensure your cargo and assets are protected.

Providing you with solvent free options that can deliver long term protection for wide temperature ranges.

Zinc Silicate solutions

Providing fit for purpose solutions for Ethanol and Methanol cargos, International's Interzinc® Zinc Silicate solutions provide excellent chemical resistance and temperature tolerance.

Containing a zinc rich chemistry Interzinc's Zinc Silicate solutions can provide rapid recoat and application to get your assets back in to service quickly making it ideal for both new construction and tank cargo conversion.

Ensuring your cargo is protected with a proven track record of success and novel testing of Ethanol and Methanol storage capabilities.

TECHNOLOGY	BENEFIT
Single coat systems	Significantly increasing application rates and reducing labor costs
Fast return to service	Less tank down time More productivity
High Temperature capability	Wider capability for storage and loading/unloading temperatures
FFA capabilities (full range)	Better and more versatile chemical resistance Longer linings service life Less contamination of cargo
Environmental Sustainability	Lower VOC emissions
Easy Application	Wide possibilities of application: brush, roll, trowel, and spray

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