

# Give a purifying boost to your renewable fuel operations

Renewable fuels retain a major role in global climate efforts, and especially renewable diesel sees fast growth. With our Tonsil® RNF series specialty adsorbents, bio- and renewable fuel producers significantly enhance the efficiency and economics of their production process by removing harmful impurities, thus prolonging the lifetime and efficiency of the high value catalysts further downstream.

Whether producing fatty acid methyl esters (FAMES) for biodiesel or the hydrotreated vegetable oils (HVOs) and animal fats commonly referred to as renewable diesel: Effective contaminant removal is vital for smooth downstream conversion and high-quality results.

The requirements of this removal differ not only for each process but also for the feedstocks used. These have moved far beyond virgin vegetable oils to include second-generation and advanced feedstocks like palm oil mill effluents (POMEs), used cooking oils (UCO/RUCOs) and waste animal fats. While supported by climate schemes like the EU's Renewable Energy Directive (RED II), the use of these new feedstocks requires a new flexibility in purification — and the right multipurpose system to succeed.

With its combination of strong binding power and high adjustability, our Tonsil® RNF portfolio provides that system. From catalyst-poisoning metals to impurities like soaps, chlorine or sugar, it reliably removes many contaminants during pretreatment and final fuel polish, while reducing feedstock losses, preventing bottlenecks and enhancing filtration.

With a partner like Tonsil® RNF at your side, almost anything's possible in purification.

## Tonsil® RNF series – activated bleaching earth with unique adsorptive powers

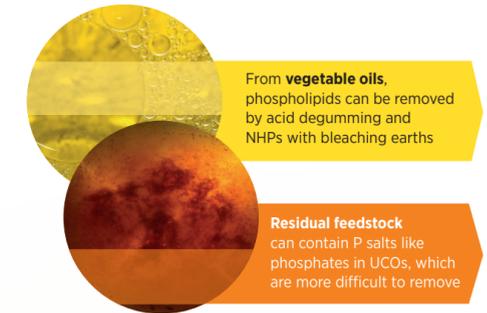
Tonsil® RNF series is a highly effective adsorbent and refining aid based on bentonite clay. It has an exceptionally high surface area, pore volume and permeability, and we make it even more effective by acid activation. It is used widely to fulfill the high standards of edible oil production, and with our long-standing expertise, we can adapt it precisely to each feedstock need.

When using Tonsil® RNF series, you join happy customers in 130 countries served by a network of 26 sites and nearly 2,000 employees worldwide. Therefore, we are able to offer you outstanding hands-on support and service worldwide.



## Different feeds, different needs – phosphorus content in residual feedstock vs. vegetable oils

While contaminants like phosphorus (P), calcium (Ca) or magnesium (Mg) are concerns both in virgin and residual feedstocks, their different chemical form in the latter often requires the use of highly advanced adsorbents with unique binding abilities. Our Tonsil® RNF series adsorbents provide these abilities and have proven success in removing metals and impurities from animal fats and other residues.



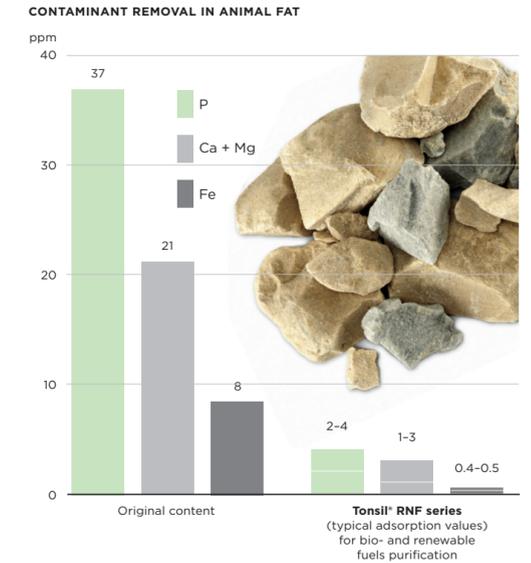
## Adsorption capabilities of Tonsil® RNF series

YELLOW GREASE – METALS REMOVAL USING HPBE (90 °C, 20 min)

Condition and analysis	Methods A.O.C.S.										Total metals [Ppm]	Metal removal [%]
	Ca 17-01					Ca 20-99						
	Ca [Ppm]	Mg [Ppm]	Fe [Ppm]	Al [Ppm]	Si [Ppm]	Na [Ppm]	K [Ppm]	P [Ppm]				
Yellow grease	-	5.5	0.3	0.3	2.7	0.3	9.8	7.9	20.2	47.0	-	-
Tonsil clay	0.75	0.5	0.2	0.2	1.9	0.3	< 0.05	0.4	0.7	4.3	91	

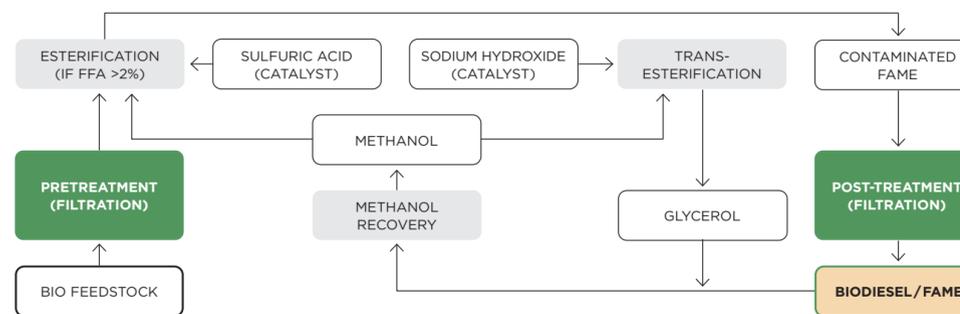
YELLOW GREASE – METALS REMOVAL USING HPBE (90 °C, 20 min)

Condition and analysis	P [Ppm]	Al [Ppm]	Ca [Ppm]	Fe [Ppm]	K [Ppm]	Mg [Ppm]	Na [Ppm]	Si [Ppm]	Total [Ppm]
	Yellow grease blend	85.0	0.1	14.7	2.9	36.0	3.4	42.0	16.0
Acid degum	37.8	0.4	9.1	1.7	12.0	1.6	17.0	4.0	83.6
Water wash	18.8	0.4	1.3	0.9	1.1	0.2	1.2	2.1	25.7
1.0% w/w bleaching clay	1.5	0.4	0.3	0.4	0.2	0.2	0.7	2.1	5.8



### Use of Tonsil® RNF in the biodiesel process

Our specialty adsorbents remove contaminants from feedstocks during pretreatment and from the reaction product during post-treatment. Depending on downstream demands, they can be used in wet bleaching, dry bleaching and precoating steps.

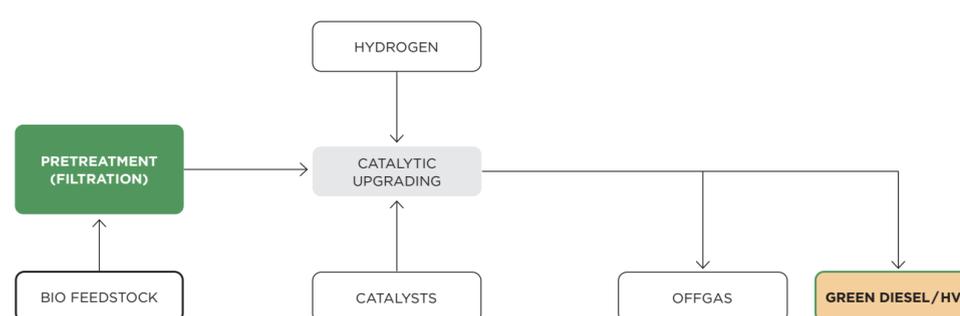


### Contaminants removed in the biodiesel process

- PRETREATMENT**
- Soaps and metals to prevent processing and catalyst issues
- POST-TREATMENT**
- Free glycerin to prevent »reversion« during demethylation and other issues
  - Excess catalyst that can cause injector deposits and/or filter plugging
  - High acidity leading to shorter shelf life and deposits in fuel systems
  - Excess alcohol able to cause injector failure and safety issues
  - Sterol glucosides and monoglycerides (particularly saturated ones)

### Use of Tonsil® RNF in the renewable diesel process

While the reaction product is a true hydrocarbon not needing post-treatment, our adsorbents fulfill the essential role of purifying feedstocks in pretreatment to prevent catalyst poisoning and other issues (as they do in the biodiesel process).



### Contaminants removed in the renewable diesel process

- PRETREATMENT**
- Phosphatides like lecithin and phosphatidylinositol to prevent catalyst poisoning
  - Particularly non-hydratable phospholipids (NHPs) stabilized by Ca and Mg
  - Other metals prone to cause catalyst deactivation, fouling or corrosion issues
  - Impurities like soaps, chlorine and sugars arising from greater feedstock variety
  - Required content of less than 1 ppm possible for many contaminants

# Benefits



## FEEDSTOCK FLEXIBILITY

Large portfolio of solutions for purifying feedstocks and fuels



## EFFECTIVE PURIFICATION

Highly efficient removal of many different types of contaminants



## ENHANCED CONVERSION

Better reaction yields and longer catalyst life due to less poisoning



## ON-SPEC POLISHING

Adsorbents can be used to purify biodiesel to required specifications

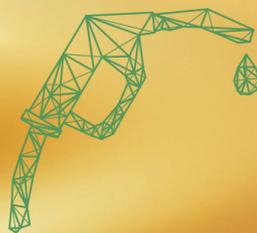


## EXCELLENT SERVICE

Experienced experts ready to assist you during start-up and operation

From varying availability and contamination to regulatory support: The growing diversity of feedstocks brings new challenges as well as new opportunities to biofuel producers.

**With our versatile Tonsil® RNF series solutions, they have all the right tools for successfully solving the ones and seizing the others!**



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OIL PURIFICATION/RENEWABLE FUELS

# The perfect recipe for purifying every fuel feedstock

