Oil-Dri
FLUIDS PURIFICATION

Meeting Renewable Diesel Adsorption Needs with Metal-X™

David D. Brooks and Bruce Patsey
Oil-Dri Corporation of America, Chicago, IL, U.S.A.
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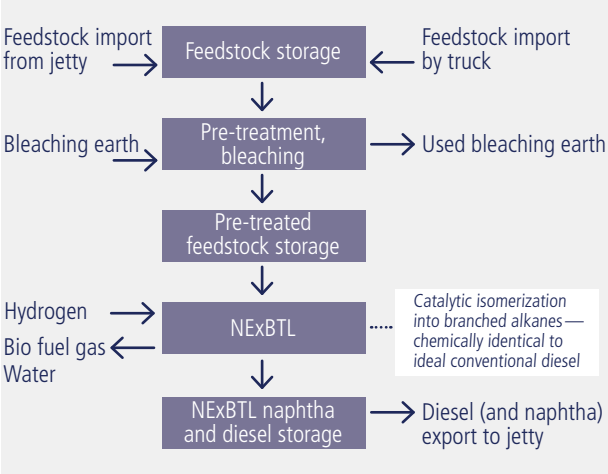
Introduction

Over the last 15 years, renewable diesel has secured its position in the bio-based sustainable fuel market. It promises a cleaner and more efficiently burning road fuel than its predecessors with less particle, hydrocarbon, and nitrogen oxide emissions. Renewable diesel goes by generic names, such has hydrogenated esters and fatty acids (HEFA) diesel, hydrogenation derived renewable diesel (HDRD), and green diesel (colloquialism).

Figure 1
Source: Neste Oil report entitled "NExBTL Renewable Diesel Singapore Plant: Tallow Pathway Description"



Catalytically driven, this process uses many cost prohibitive fats and oil-based feedstocks that cannot be economically converted into biodiesel fuels.

The hydrogenation process (Figure 1), employing expensive precious metal catalysts, requires protection from several contaminants detected and monitored as trace elements (Figure 2) in any given feedstock. Removal of these catalytic poisons to acceptable concentration levels is paramount to achieving favorable economics. Refineries, accordingly, established a need for superior metal-scavenging sorbent to protect the bed life of the catalyst.

Figure 2

Contaminant Removal: Desired Levels
< 1–5 ppm Phosphorous
< 5 ppm Nitrogen
< 5 ppm Sulfur
< 50 ppm Chlorine
< 5 ppm Total Metals (Ca, Mg, Na, Si, K, Fe, Al)
Good Filtration: < 10% -5 µm fines

Metal X

Founded on a spirit of innovation, Oil-Dri Corporation of America introduces **Metal-X™**, a sorbent specifically developed to meet filtration demands and adsorptive needs of the sustainable renewable diesel market.

Metal-X effectively and efficiently protects downstream catalyst beds from catalyst poisons, including compounds containing those listed in Figure 2. Metal-X is chemically fortified to exceed the common efficiencies of acid activated and natural bleaching clay products currently on the market.

Refiners employ various sorbents to drive concentrations of these catalyst poisons to sub 5 ppm levels.

Figure 3

General Processing Steps

- Pre-Filtering
- Wet Degumming
  - Water: ~2%
  - Super Degum w/ Citric or Phosphoric; < 1500 ppm
- Centrifuging
- Acid Pretreat
  - Citric or Phosphoric < 1500 ppm; 0.5% FM
- Bleaching
  - Typically < 1%; when P levels under 20 ppm
- Filtering; Standard & Polish Filters

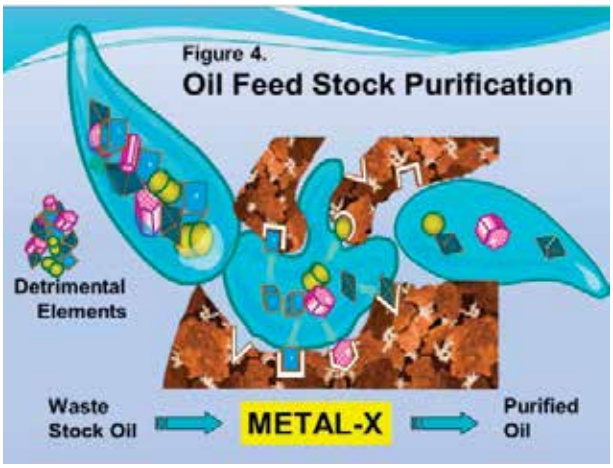
Efficacy of the bleaching process can be improved by application of traditional refining process techniques (prefiltering, washing, and degumming) to achieve manageable contaminant concentrations prior to entering the bleaching process (Figure 3).

Comparing Metal-X to Bleaching Earths

Metal-X starts with a palygorskite base clay, a naturally active clay mined from the Ochlocknee region in Georgia, U.S.A. Unique in structure, porosity, and physical characteristics, palygorskite clay naturally promotes excellent flow and adsorption efficacy. It is able to adsorb a range of contaminants including colorants, phosphorous compounds, and trace elements from both refined and waste oils and fats — making it ideal for renewable diesel.

Renewable diesel feedstocks contain numerous impurities that must be effectively reduced to minimal parts-per-million concentration levels before converting them into usable fuel. As depicted in Figure 4, fluids absorbed along with contaminants can migrate via a tortuous path within the Metal-X interconnected networks of capillary channels. Detrimental impurities are drawn into Metal-X's pores and subsequently adsorbed within the Metal-X matrix.

Figure 4



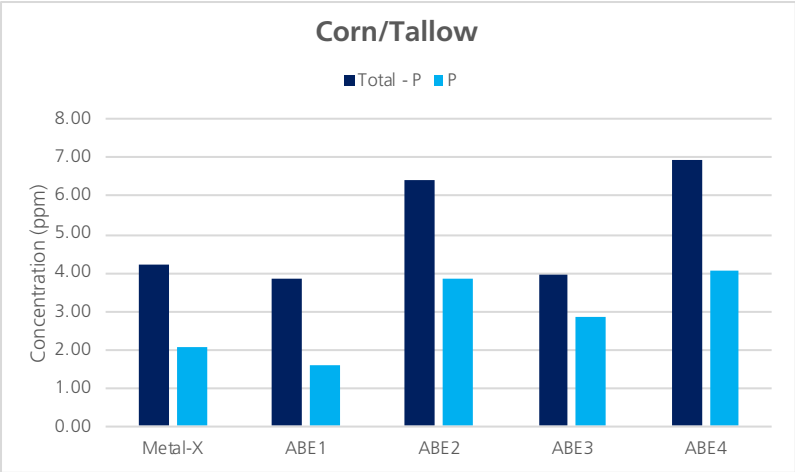
Proven Metal-X Performance

Adsorption evaluations across three typical feedstocks (a tallow-corn oil blend, a palm-tallow blend, and a super degummed [SD] rapeseed/canola oil) demonstrate the performance differences between Metal-X and commercial active bleaching earths (ABE1-4) (Figures 5-7).

Metals Reduced

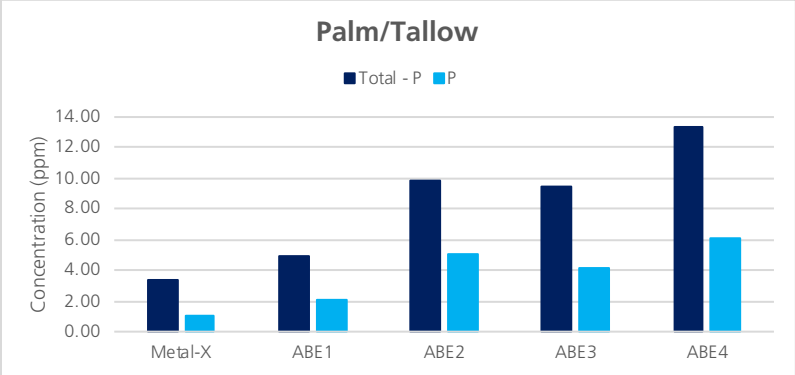
- Total Metals (Al, Ca, Fe, K, Mg, Na, Si)
- Total Phosphorous

Figure 5



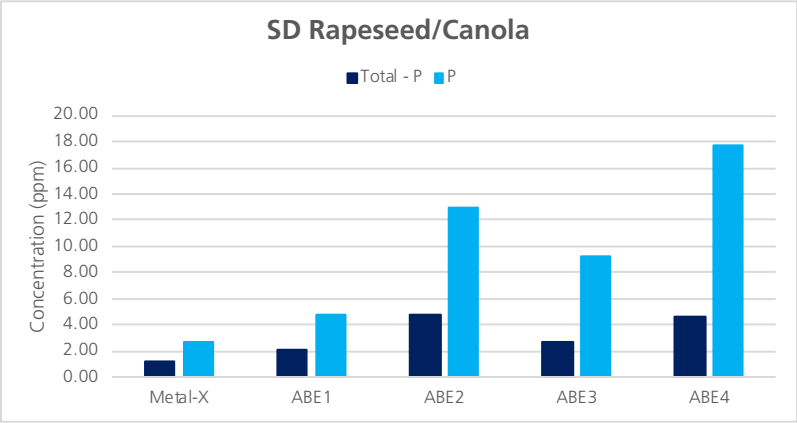
The start oil parameters for the corn and tallow blend tested were 20.99 ppm for phosphorous and 14.23 for all other metals (aluminum, calcium, iron, potassium, magnesium, sodium, and silicon). As shown in Figure 5, Metal-X competitively reduced levels of phosphorous by 90.1% and 70.4% of all other metals, resulting in a concentration of 2.08 ppm and 4.22 ppm for phosphorous and all other total metals accordingly.

Figure 6



The start oil parameters for the palm and tallow blend tested were 16.38 ppm for phosphorous and 43.56 for all other metals (aluminum, calcium, iron, potassium, magnesium, sodium, and silicon). Figure 6 shows Metal-X outperforming all active bleaching earths, reducing levels of phosphorous by 93.4% and 92.3% of all other metals. This resulted in a concentration of 1.08 ppm and 3.37 ppm for phosphorous and all other total metals accordingly.

Figure 7



The start oil parameters for the SD rapeseed/canola oil tested were 48.95 ppm for phosphorous and 17.21 for all other metals (aluminum, calcium, iron, potassium, magnesium, sodium, and silicon). Figure 7 shows Metal-X outperforms other active bleaching earths on the market. Oil-Dri's product reduced levels of phosphorous by 94.7% and 92.7% of all other metals, resulting in a concentration of 2.62 ppm and 1.26 ppm for phosphorous and all other total metals accordingly.

Conclusion

Testing shows Metal-X outperforms or is competitive with other active bleaching earths that are common to Europe and the Americas. Its distinctive performance attributes—a chemically fortified active surface area and natural porosity—enables it to meet the diverse adsorption and filtration demands of the renewable diesel market. When compared against four other active bleaching earths across three oil-based feedstocks, Metal-X demonstrated, on average, up to 20% lower reduction of phosphorous and all other metals. This proves Metal-X can preserve catalyst resources by effectively and efficiently removing contaminants and meeting desired acceptable concentration levels for renewable diesel.

410 North Michigan Avenue | Suite 400 | Chicago, Illinois 60611 | United States of America
+1 312 321 1515 | www.oildri.com/fluids | info@oildri.com