



Methane Sulfonic Acid - Low Corrosion

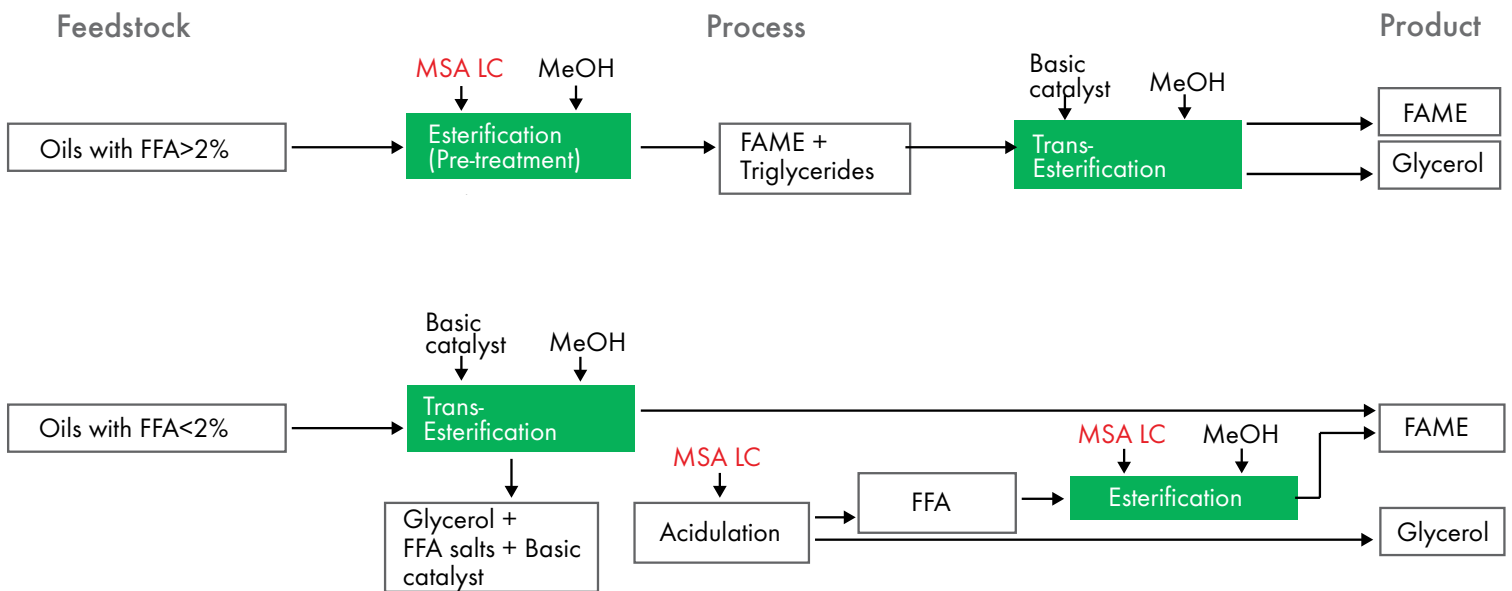
The Advanced Acid Catalyst in Biodiesel Manufacturing

Arkema, in keeping with its quest for innovation that serves customers, introduces to the biodiesel industry **MSA LC**, a low corrosion version of its methane sulfonic acid (MSA). It provides the following outstanding benefits:

- High yields of quality biodiesel (fatty acid methyl esters or FAME) via enhanced selectivity
- Corrosion reduction in the whole process if used as illustrated below
- Reduction of waste streams
- Versatile acid in biodiesel manufacture for catalysis, acidulation and neutralization

MSA LC is equally effective on feedstocks containing 2% to >10% free fatty acid (FFA) content. Typical protocols followed are:

- **If FFA >2%**; biodiesel producers usually carry out the pre-treatment step transforming FFA to FAME by esterification in the presence of methanol and **MSA LC**. The intermediate mixture then undergoes an alkali-catalyzed transesterification reaction to produce FAME.
- **If FFA <2%**; **MSA LC** is used to acidify the glycerol phase obtained after transesterification to convert soaps (FFA salts) back to FFA. This FFA can then be esterified using **MSA LC** and methanol to produce additional FAME.



BENEFITS OF MSA LC FOR BIODIESEL PRODUCERS

MSA LC is an exceptional acid that has the same well known performance properties as commercially available MSA but with significantly reduced corrosivity towards 304L and 316L stainless steels.

Arkema looks to build strong relationships with a select group of versatile global biodiesel producers using a diverse range of feedstocks.

Arkema believes these producers will observe the following **advantages when using MSA LC to produce biodiesel**:

- Higher conversion yield and better selectivity
 - Significant corrosion reduction in primary and secondary process units
 - Elimination/reduction in waste treatment.
- MSA LC** and its salts are completely biodegradable with low COD

- Better color and clarity
- Flexibility to use diverse feedstocks with a wider range of FFA content
- Greater financial benefits of using cheaper "high FFA content" feedstock

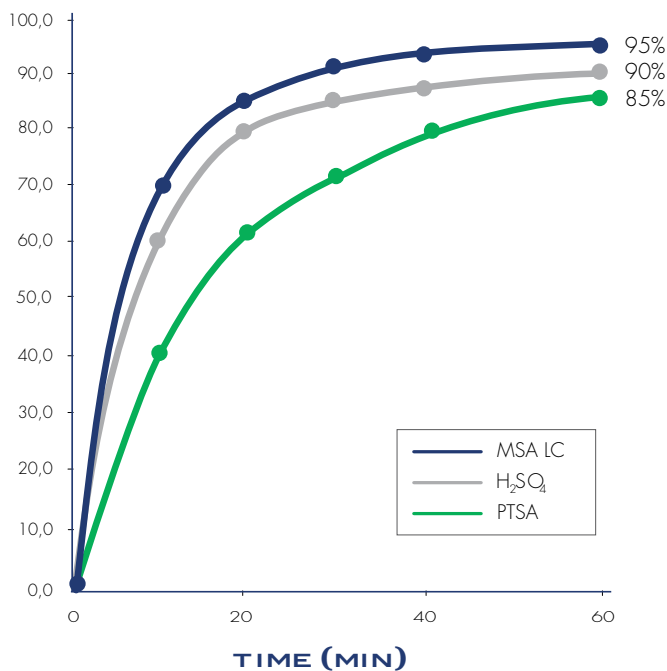
MSA LC – RELATIVE PERFORMANCE OVER OTHER ACIDS:

Acid	Yield	Kinetics	Corrosion	Sulfate Content	Biodegradability	Metal Content
MSA LC	3	3	0	1	3	0
MSA	3	3	2	1	3	0
Sulfuric Acid	2	3	3	3	0	2
PTSA	3	2	1	2	1	1
Phosphoric Acid	2	1	2	0	0	2

From the table above, it is clear that **MSA LC** provides optimum value to biodiesel manufacturers. (0: Negligible, 1: Small, 2: Medium, 3: High)

CONVERSION OF FREE FATTY ACIDS Comparison of MSA LC versus commonly used Acids

Feedstock: Used Cooking Oil with ~8% FFA



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