IMPROVED TECHNOLOGY FOR PRODUCTION OF PALM-BASED ESTERQUATS

by: HALIZA ABDUL AZIZ and ZAINAB IDRIS

375

MPOB INFORMATION SERIES • ISSN 1511-7871 • JUNE 2007 MPOB TT No. 361

Quaternized fatty acid triethanolamine esters or esterquats are cationic surfactants, nowadays preferred over the traditional quats because of their excellent biodegradability. The uniqueness of the esterquats molecule is due to the presence of at least one ester group between the long hydrocarbon chain and triethanolamine hydroxyl group (*Figure 1*). This ester linkage is easy to hydrolyse to give fatty acids and short chain quats. The palm-based esterquats developed by MPOB were readily biodegradable, reaching the 60% pass level in only three to four days. The biodegradability of palm-based esterquats is comparable to that of tallow-based commercial esterquats (*Figure 2*). Moreover, palm-based esterquats, derived from a vegetable and a renewable-based feedstock are more acceptable to many people than an animal-based raw material.

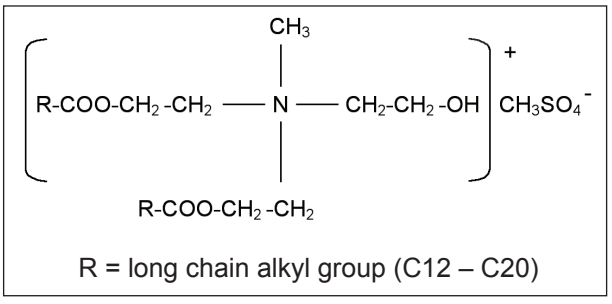

Figure 1. Structure of palm-based esterquat.

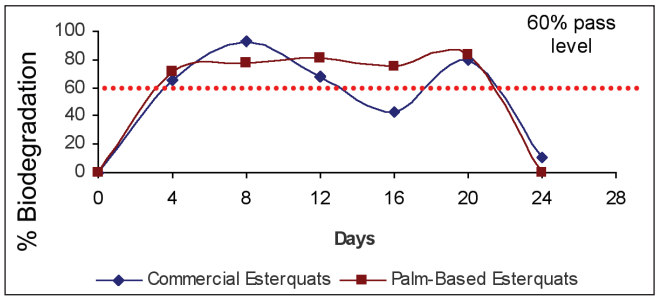

Figure 2. Biodegradability of esterquats.

TECHNOLOGY FOR ESTERQUAT PRODUCTION

Currently, MPOB has a pilot plant that can produce 25 kg batch^{-1} of esterquats (*Figure 3*). The production is a two-stage process - preparation of esteramines in the first stage and quaternizing the esteramines with dimethyl sulphate subsequently in the second stage. The esteramines are usually a mixture of mono-esteramine, di-esteramines and tri-esteramines. Palm-based esterquats can be produced from fatty acids or methyl esters, easily obtainable from Malaysian oleochemical and biodiesel plants.

FATTY ACID ROUTE

Esteramines can be produced by esterification of palm stearin fatty acid and triethanolamine (>99%) in the presence of an acid catalyst. They are then quaternized with dimethyl sulphate to produce esterquats. The esterquats contain 60% - 63% active matter with colour Lovibond 3-4 (red scale). Water is produced as a by-product.

METHYL ESTER ROUTE

The production of esterquats via the methyl ester route involves transesterification of palm-based methyl ester and triethanolamine (>99%) in the presence of a basic catalyst. Methanol is produced as a by-product. Similarly, the esteramines are quarternized with dimethyl sulphate. The properties of the esterquats produced via this route are summarized in *Table 1*.

ISSN 1511-7871
9 771511 787001

Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-87694400 Website: http://mpob.gov.my Telefax: 03-89259446

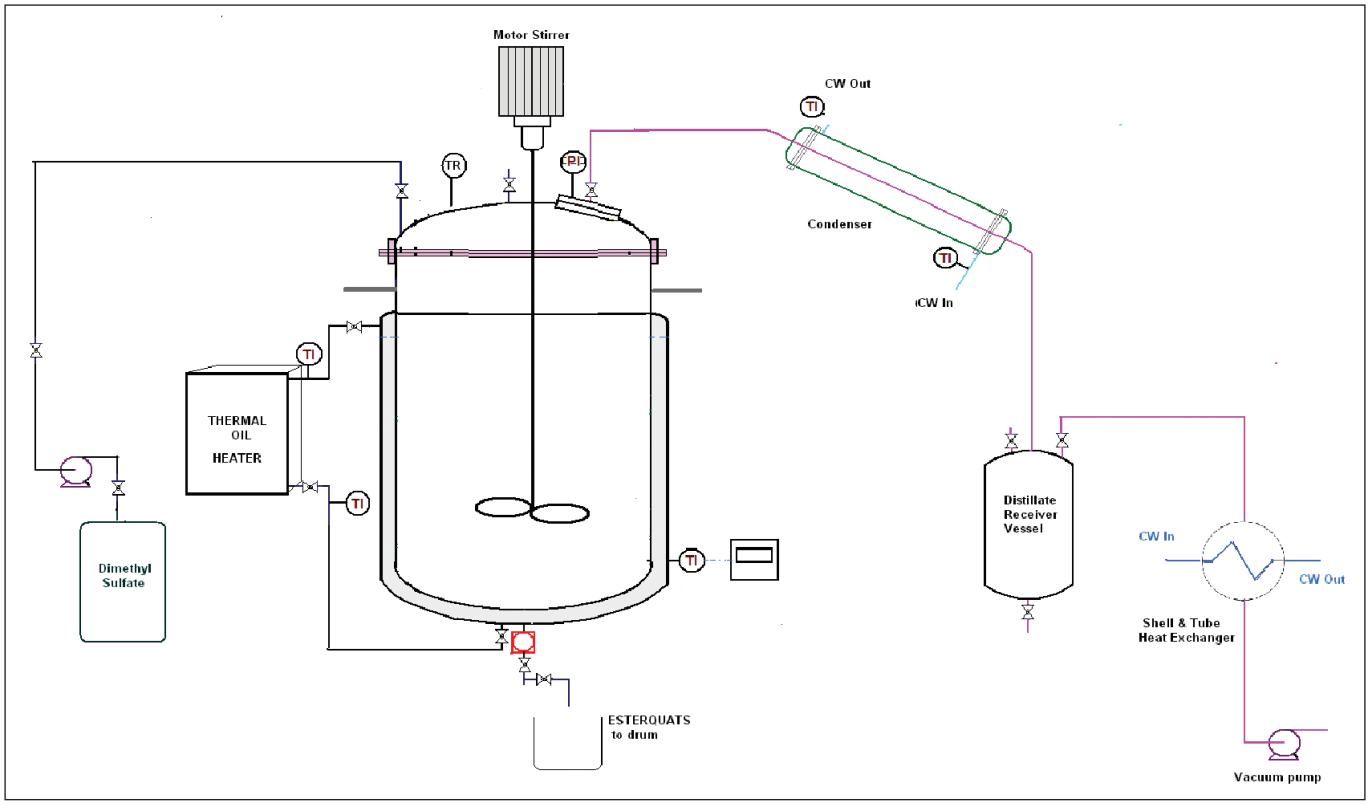

Figure 3. Schematic diagram of 25 kg batch^{-1} pilot plant.

TABLE 1. PROPERTIES OF PALM-BASED ESTERQUATS *vs.* TALLOW-BASED COMMERCIAL ESTERQUATS

Parameter	100% H-ME	90%H-ME, 10% non H-ME	50%H-ME, 50% non H-ME	10%H-ME, 90% non H-ME	100% non H-ME	Commercial esterquats (tallow)
Appearance	Paste	Paste	Paste	Paste	Paste	Paste
Active matter %	60.8	60.0	51.9	60.1	60.1	60% – 63%
Colour Lovibond	1.2R	4.9R	3.8R	5.4R	14.5R	2.9R
5% pH solution	3.3	3.2	3.3	3.5	3.3	2.5 - 3.5
Total solid content %	91.3	90.8	90.2	90.8	90.1%	85.0%

Note: * H-ME: hydrogenated palm-based methyl ester; non-H-ME: non-hydrogenated palm-based methyl ester.

ADVANTAGES OF THE METHYL ESTER ROUTE OVER FATTY ACID ROUTE

The methyl ester route is preferred over the fatty acid route because the process conditions required are milder - lower vacuum and temperature. Furthermore, the reaction time is 1 hr *vs*. 4 hr by the fatty acid route.

APPLICATIONS OF ESTERQUATS

The major potential market for esterquats is in textiles as the global leading ingredient for fabric softeners. MPOB has confirmed the technical viability of palm-based esterquats as an active ingredient in fabric softeners to replace tallow-based esterquats formulations currently in the market. Other applications of esterquats are shown in *Figure 4*.

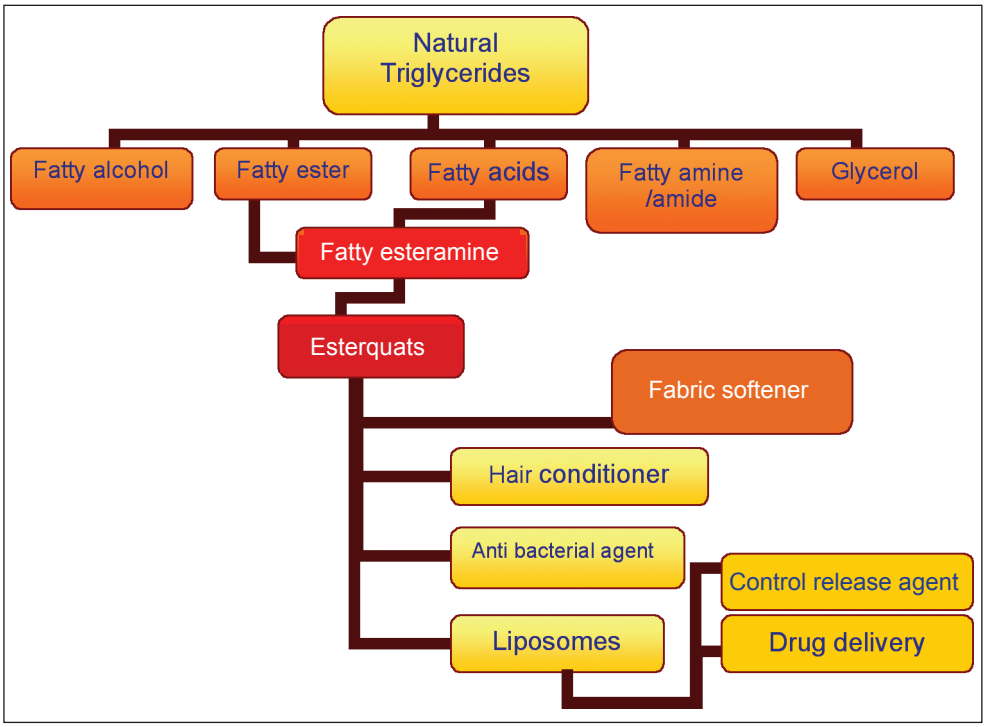

Figure 4. End-product applications of palm-based esterquats.

Figure 5. Palm-based esterquats and fabric softener.

ECONOMIC ANALYSIS

- Payback period - 5 years.
- Return on investment (ROI) - 19%

CONCLUSION

The production of palm-based esterquats has been scaled up from laboratory scale to a 25 kg batch^{-1} pilot plant. A milder process (methyl ester route) is employed, replacing the fatty acid route used earlier. The methyl ester route improves the process efficiency as well as reduces the processing time. The properties of the palm-based esterquats produced are comparable to those of commercial tallow-based esterquats. The major application of esterquats is in textiles, used as active ingredient for fabric softeners.

For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-87694400
Website: http://mpob.gov.my
Telefax: 03-89259446