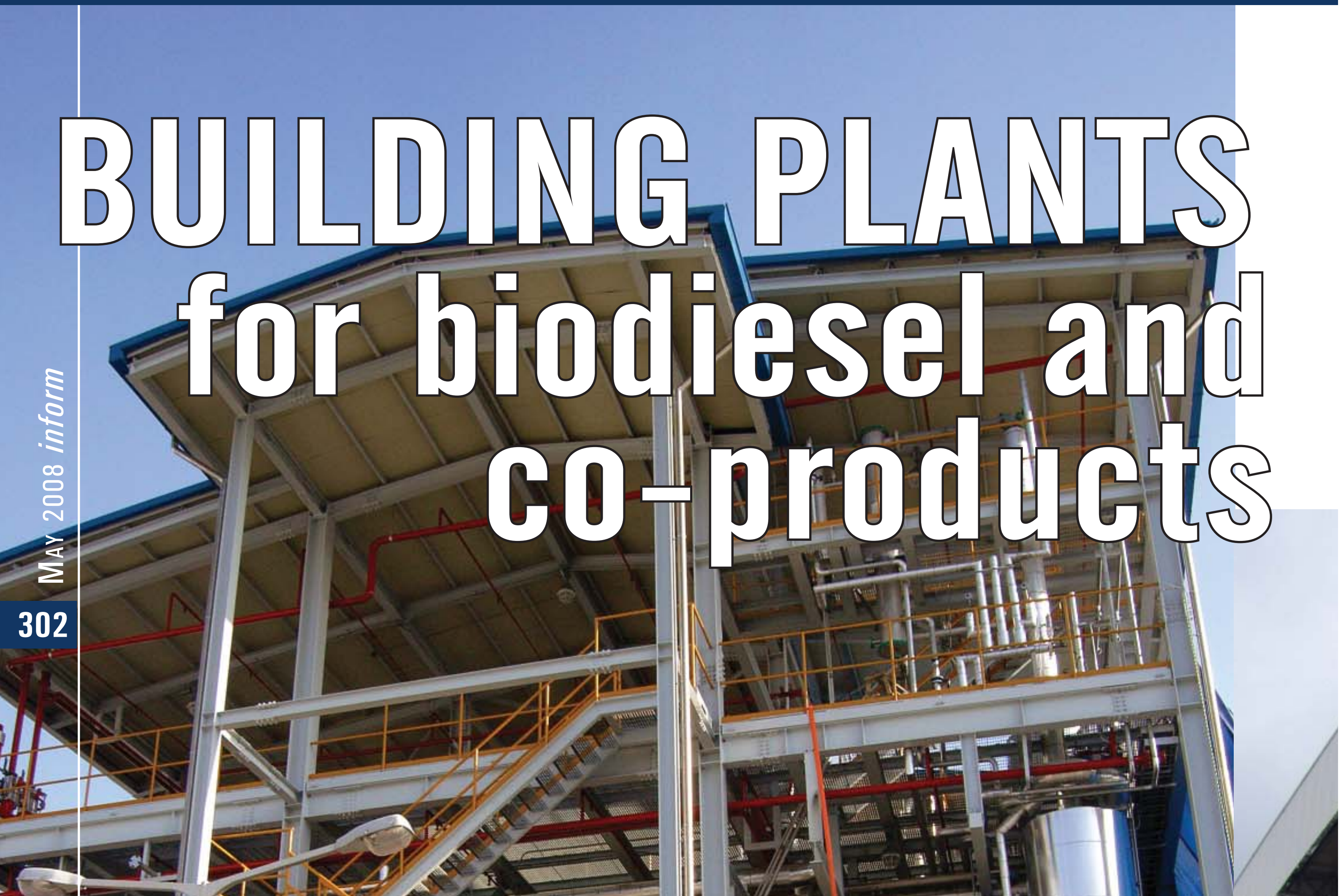
BUILDING PLANTS for biodiesel and co-products



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The surge in feedstock prices for biodiesel plants over the past year has had a negative impact on the viability of many biodiesel plants and projects. Existing biodiesel plants are either not operating or are running at low capacities. Many biodiesel projects have also been either delayed or shelved. With edible oil prices at all-time highs, biodiesel producers need not only to keep their costs of production as low as possible but also to find new ways to use their plants to ensure the long-term survival of their operations. For example, at least one major biodiesel producer with glycerin-refining facilities in Southeast Asia plans to purchase crude glycerin for processing to higher-value pharmaceutical-grade glycerin to maintain plant operations. The combination of using lower-cost feedstock, low operational costs, and production of value-added co-products can tip the balance to one of profitability instead of loss for biodiesel producers.

FEEDSTOCK

A key consideration when building a biodiesel plant is access to feedstock. A backward-integrated biodiesel producer ensures security of feedstock supply. Proximity to the feedstock in addition to excellent transportation and storage infrastructure and facilities helps mitigate the cost of feedstock and at the same time facilitates shipments of products and co-products to markets and end users.

A multiple-feedstock processing facility will ensure that the most economical feedstock is utilized for the plant operations. This also determines the pretreatment processes necessary for the processing of the feedstock for conversion to biodiesel. The choice of using chemical or physical refining plants will be added to the processing equation.

BIODIESEL PROCESS TECHNOLOGY

Although the use of vegetable oils and their derivatives as a transportation fuel was first explored early in the 20th century, the energy crisis in 1973 spurred more concerted developments in this field in Europe and the United States in the 1970s and the 1980s. By the early 1990s, Europe was the global leader in the manufacture of biodiesel on a large industrial scale, using mainly rapeseed oil as feedstock, whereas the United States was a distant second, using mainly soybean oil as feedstock. The early 21st century saw a dramatic increase in the global production of biodiesel at a time when prices of vegetable oils dipped while petrodiesel prices were relatively high.

In Malaysia, work on palm oil-based biodiesel started in the 1980s and culminated, in 2006, in the world's first large-scale integrated palm oil-based commercial biodiesel facility, Carotino Sdn. Bhd., located in Pasir Gudang, Malaysia. This plant now exports its biodiesel mainly to Europe and the United States.

Although the transesterification process to convert vegetable oil to biodiesel has remained the same over the past 40 years, the basic process has evolved and been adapted to suit the feedstocks available where the biodiesel is manufactured. Therefore, the choice of process-plant supplier is a key consideration for the biodiesel producer. A good process plant track record in producing biodiesel (using the feedstock available in the processing country) that meets all parameters of the end-user's biodiesel standards is paramount for the producer in this very competitive industry where product quality cannot be compromised. Ease and stability of process operations coupled with a high level of automation ensure not only reliable plant operations but also consistent product quality. These criteria must also be factored into the choice of process plant supplier.

One major cost in the conversion of oils to biodiesel is the cost of catalyst. Very significant savings can be obtained when using low-cost, high-purity sodium hydroxide solid catalyst instead of sodium methoxide solution, favored by the majority of process-plant suppliers. The cost advantage for sodium hydroxide can be as much as $1 million per annum for a biodiesel plant having a capacity of 100,000 metric tons per year.

The so-called issues when using sodium hydroxide, as put forward by its detractors, have largely been circumvented, as borne out by the excellent conversion process and very high-quality biodiesel produced by these plants, some of which already have been operating for more than one-and-a-half years in Malaysia and Korea without any issues. Sealing the sodium hydroxide, in the form of high-purity solid pellets, into 1,000-kg bags for delivery makes the catalyst very amenable to semi-automated handling systems. Well-designed sodium hydroxide catalyst preparation and dosing systems, coupled with the high purity of recovered methanol used in this low-temperature process, have enabled these plants to operate extremely reliably.

The biodiesel industry is currently facing difficult times owing mainly to the surge in feedstock prices. Until these prices ease or alternative feedstocks emerge in the medium term, many producers may have no choice but to operate either at low capacities or, in the worst case scenario, cease operations altogether. However, proven process technologies are available to biodiesel producers that either reduce their conversion costs or result in high value-added co-products.

CO-PRODUCT PROCESS TECHNOLOGIES

The recent rise in crude and pharmaceutical-grade glycerin prices has helped to offset high feedstock costs. However, this is insufficient to alleviate the plight of biodiesel producers who may be faced with running their plants at a loss to fulfill their biodiesel delivery commitments. A producer needs seriously to consider investing in other complementary processes that yield high value-added co-products to ensure the economic viability of their operations (see Fig. 1).

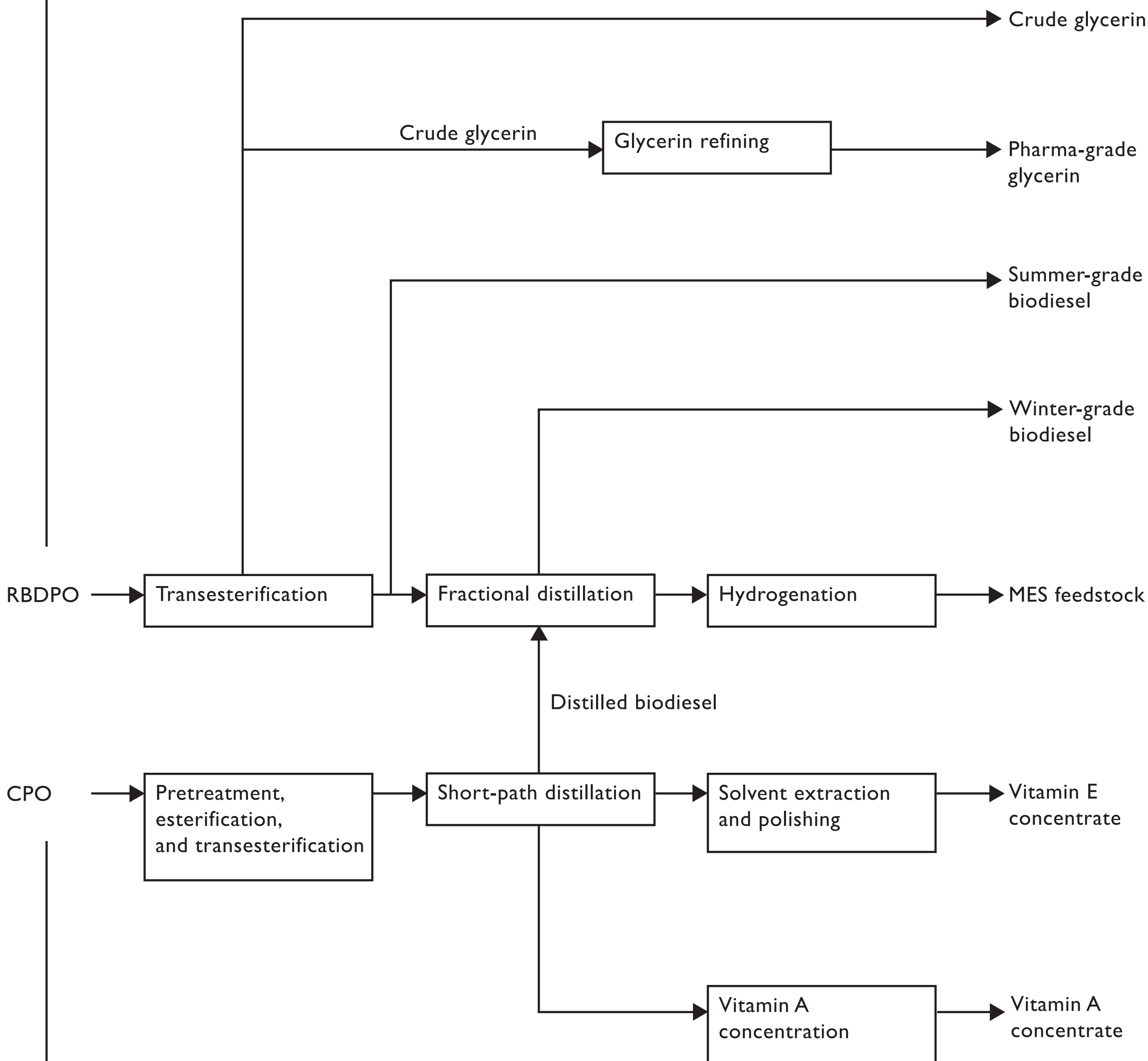

FIG. 1. *Schematic of the production of biodiesel and co-product from crude palm oil (CPO) and refined, bleached, and deodorized palm oil (RBDPO). MES, methyl ester sulfonates.*

Palm oil offers a unique advantage in making available to the producer a wider range of co-products than are available with other feedstocks. Starting with crude palm oil (CPO) and refined, bleached, and deodorized palm oil (RBDPO), a biodiesel plant can incorporate processes to produce palm biodiesel having cold-filter plugging points of +6 and +15°C, feedstock for methyl ester sulfonates (MES), and vitamin A and E extracts in addition to the traditional by-products of crude and pharmaceutical-grade glycerin.

In the transesterification plant, starting-material RBDPO is converted to summer-grade palm biodiesel. This biodiesel then undergoes either a partial crystallization or fractional distillation process to remove the C_{16} fraction, which is further hydrogenated to produce a feedstock suitable for the manufacture of MES, a highly cost-effective substitute for linear alkyl benzene sulfonates (LABS: a product normally derived from the petrochemicals industry). MES and LABS are key ingredients in the detergent industry.

In the bleaching section of the pretreatment plant, CPO is pretreated to remove impurities such as heavy metals and gums. This process preserves the phytonutrients (carotenes, tocopherols, tocotrienols, etc.) of CPO that would otherwise be destroyed in the physical refining process. The pretreated CPO is subsequently esterified and transesterified (using the existing transesterification plant process) to produce palm biodiesel. This is further processed using short-path distillation technology to give three product streams—distilled biodiesel, which is fed into the fractional distillation plant for removal of C_{16} to produce winter-grade biodiesel; vitamin A, which is subsequently concentrated to obtain a carotene (vitamin A) concentrate; and, finally, a vitamin E feedstock, which is further processed by additional transesterification, polishing, and solvent fractionation to obtain a vitamin E concentrate. The output capacities of the vitamin A and E concentrates range between 50 and 100 kg per day. These high-value products can fetch prices of $150–$430/kg.

CONCLUSIONS

The biodiesel industry is currently facing difficult times owing mainly to the surge in feedstock prices. Until these prices ease or alternative feedstocks emerge in the medium term, many producers may have no choice but to operate either at low capacities or, in the worst case scenario, cease operations altogether.

However, proven process technologies are available to biodiesel producers that either reduce their conversion costs or result in high value-added co-products, which will together make the difference between profitability or loss. As with any industry, there exist cycles of boom and bust. Although the current situation for the industry is extremely challenging, producers will need to find viable solutions and implement them quickly to ride out these difficult times so as to be in a strong position to ride on the next wave of biodiesel expansion when it comes in the near future.

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