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LETTER TO THE EDITOR

Artificial Neural Network or Common Sense Based on Insight?

Albert J. Dijkstra

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Dear Sir,

In the November issue of *JAOCS*, you published an article [1] on the use of an artificial neural network for process optimization. I started reading this article with great interest and out of curiosity about this process investigation technique, which, as far as I am aware, has not been the subject of any article in this journal before. However, I soon realized that the authors lacked insight into the chemistry of the degumming process, as a result of which the model the authors propose has little to offer and is even misleading.

The combined degumming and bleaching process of palm oil studied by the authors is commonly referred to as the "dry degumming process" [2, 3]. It involves a decomposition of the non-hydratable phosphatides (NHP) present in the oil by phosphoric acid, followed by a bleaching earth treatment. It is very suitable for oils and fats with low NHP-content (palm oil, lauric oils and animal fats) and has the advantage that it reduces the number of refining steps to only two: dry degumming and physical refining.

When summarizing their process, the authors mention that the amount of phosphoric acid used in Malaysian industrial palm oil refineries varies between 0.5 to 1.0 wt% of crude palm oil, and that the amount of bleaching earth varies between 1.0 to 2.0 wt%. In this respect, they disagree with a presentation at a recent short course [4], where 0.1 and 0.07 wt%, respectively, were reported.

The authors provide a flow diagram of the combined process (Fig. 1).This flow diagram shows that the phosphoric acid is mixed with an unspecified fraction of the crude palm oil, and that the bleaching earth is mixed with the remainder. Subsequently, the oil stream containing the phosphoric acid and the oil stream containing the bleaching earth are both fed into a degumming and bleaching vessel. The temperature in this vessel is 100°C, the pressure 7 kPa, and the contact time in the batch process is 30 min. The strength of the phosphoric acid and the type of mixer used to disperse the phosphoric acid in the oil are not mentioned.

Adding phosphoric acid to only part of the oil completely negates its role in degumming: the decomposition of NHP. For the phosphoric acid to react with as large a fraction of the NHP present as possible, a number of conditions must be met:

- The acid strength must be at least 20 wt% to obtain low residual phosphorus levels in the degummed oil [5];
- The acid strength should not exceed 60 wt% since higher strengths of phosphoric acid may form adducts with oil components such as unsaturated fatty acids [5];
- The acid has to be very finely dispersed in the oil [6, 7];
- Moreover, the acid should be dispersed in the entire amount of oil and not just in a fraction of the oil as practiced by the authors [1].

In fact, what the authors propose can be compared to a neutralization process in which some phosphoric acid is mixed with part of the oil and caustic soda is mixed with the remainder of the oil, whereupon the two streams are combined. On combination, the caustic soda will immediately neutralize the phosphoric acid so that the stream into which the caustic soda had been mixed will never undergo an acid treatment. It is immediately obvious that this neutralization process does not make sense and optimizing such a process does not make sense either.

In a recent article [8], I expressed my opinion: "that the dry degumming process could profit from further investigation and development that might involve partial neutralization of

A. J. Dijkstra (✉)
Carbougnères, 47210 St Eutrope-de-Born, France
e-mail: albert@dijkstra-tucker.be

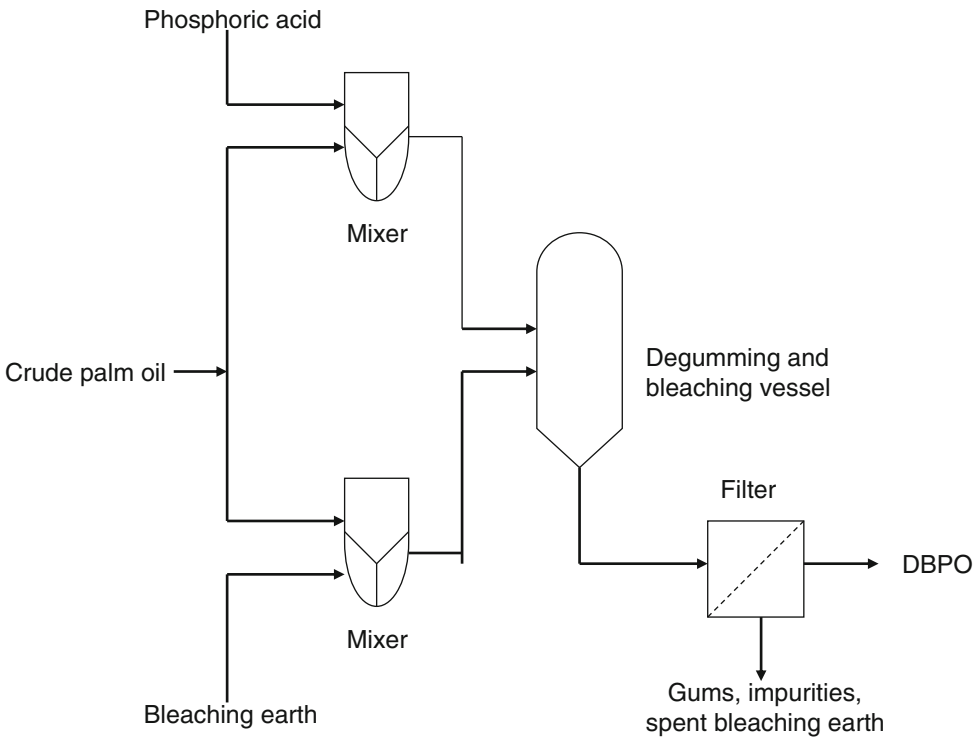

Fig. 1 Flow diagram of combined process (redrawn from [1])

the degumming acid prior to the bleaching earth addition such as disclosed by Nock [9] for oils containing more phosphatides than the oils now being dry degummed."

The article under discussion here [1] provides further support for this opinion in that it purports to investigate the dry degumming process. It also reveals substantial potential savings by reporting that the amount of phosphoric acid used for the degumming of palm oil with less than 20 ppm P is probably five times higher than what has been found to suffice for oils with an NHP content corresponding to 200 ppm P. Since part of the bleaching earth will be required to mop up the phosphoric acid, using less acid will also save on bleaching earth.

Accordingly, using insight-based common sense that calls for (1) ensuring a proper dispersion of (2) less phosphoric acid of (3) appropriate strength in (4) the entire amount of oil, already realizes larger savings than the result of using an artificial neural network. I therefore disagree with the authors of [1] that their "results point towards a possible optimization for combined degumming and bleaching which can be translated into significant savings in cost and time through the use of artificial neural network models."

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