

In the pilot plant, clarification was carried out in a continuous settling <sup>of</sup> 200 litres capacity (vide figure 35). The conclusions drawn from experiments carried out therein are summarised below:-

- /tank
- i) Capacity: The 220 litres settling tank has a working volume of 150 litres. It can cope with 500 kg of diluted crude oil per hour (100% dilution with water). Crude <sup>therefore</sup> settles for approximately 0.3 hour (18 minutes). /oil
  - ii) Oil recovery: Approximately 60% of the oil is recovered.
  - iii) Separation of NCS: Almost total separation is achieved since only 1.5% of the impurities find their way into the oil. The average moisture and dirt content of the continuously settled oil is 1.3% and 0.06% respectively. This is too high and would not be suitable in an industrial process.
  - iv) Interface: At times the interfacial layer tends to increase and to occupy the space intended for clean oil (density close to that of oil). At that point, the crude oil feed is reduced slightly and, after a few minutes, enough oil has separated to enable continuous settling to take place again. The hourly capacity of 500 kg allows for the slowing down of the feed.
  - v) Removal of sludge: The output is steady. The composition of sludge is constant. Oil content ranges from 11 to 13% and NOS from 4 to 6.5% (12 analyses).
- b) Clarification of wet process crude oil

A lot of difficulties was experienced, probably as a result of the high colloid content of crude oil. The efficiency does not exceed 65 to 70%.

- c) Clarification of centrifuge crude oil

The process offers no difficulties. A single static separation leads to an efficiency of 94 to

It was pointed out in Chapter III that the addition of surfactants was tried in an attempt to improve the efficiency of oil extraction from the cake. The addition was carried out either directly in the digester or by washing the cake at the end of the centrifugation run. It is of interest to mention the effect of the addition of surfactants on the settling characteristics of crude oil. For instance, the rate of settling of 3 samples of oil is given graphically in figure 36: (i) Control oil, (ii) Oil treated with 0.025% of alkyl-aryl-sulphonate, (iii) Oil treated with 0.5% of A.A.S.

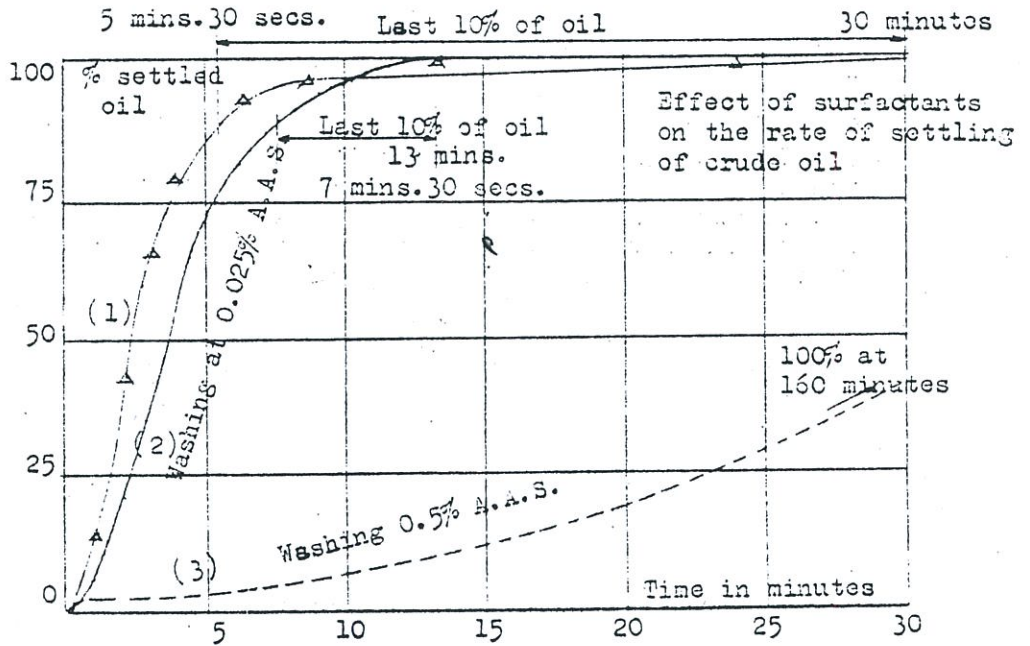
The examination of graph 36 leads to the following observations:-

- i) The control oil separated completely after 30 minutes.
- ii) No.2 oil separated completely after 13 minutes.
- iii) No.3 oil decanted completely in 160 minutes. In that experiment, it was not possible to boil the oil (this was done for the other two tests) as a result of the formation of a large amount of foam (the tank overflow).
- iv) The addition of water containing 0.025% of alkyl-aryl-sulphonate slows down settling at the beginning of the operation, but the rate of settling at the end of it decreases less markedly than in the case of the control oil. As a result, the last 10% of oil of the control require 24 minutes to settle whilst in the case of No.2 oil only 5.5 minutes are needed.
- v) The addition of 0.5% of alkyl-aryl-sulphonate slows down settling considerably.

The analysis of the bottom layer in the case of oils No.1 and 2 indicates that after the times given above there is no more oil capable of further settling.

The same process was used with crude oil from continuous presses. No increase in the rate of settling was recorded whilst quite a lot of oil was found to remain in the bottom layer.

Figure 36



d) Factors affecting settling

It had been observed that screening improved the settling characteristics of crude oil because of the coalescence of the globules. A laboratory experiment showed that subjecting crude oil to high frequency vibrations led to increased settling ability. The technique was tried at semi industrial scale with screw press crude oil subjected to ultrasounds. The apparatus consists in a bell with a reed in its centre. The reed vibrates as a result of the flow of oil under high pressure (frequency of 18,000 to 22,000 cycles per second).

Ultrasounds of that frequency do not induce coalescence of oil globules. On the contrary, they greatly stabilise the emulsion. The use of vibrating reeds connected to an electromagnet (frequency 50 c/s) leads to coalescence around the reeds but no increase in the rate of settling is recorded.

As has been already mentioned, boiling improves the settling of crude oil. If steam injection is used it should be assumed that the crude oil actually

The dehydration of crude oil, if carried out far enough, enables fast separation of the non oily solids. These can be removed. They contain 60% of oil and can be pressed. Although dehydration of crude oil can be easily carried out in the laboratory by evaporation under vacuum it is difficult to envisage a practical application of that technique. The fact that dehydration makes good separation possible should however be recorded.

Similarly, the good settling characteristics of crude oil derived from dehydrated fruit is worthy of mention (See annex 1).

### B. Screening

Screening which has been applied on the oil derived from the four extraction processes and on all types of fruit appears to be indispensable in palm oil milling. It can be carried out on crude oil as well as on sludge after the first separation. The advantages and disadvantages of the two systems were compared.

In practice, it may be concluded that the point of the circuit where the screen is incorporated is not important. In all cases the solids retained by the screen contains a lot of oil and must be recycled.

#### Washing of the solids

The recycling of the solids is not a complicated operation but nevertheless requires labour or power and entails additional expenditure, unless the solids can be reintroduced into the digester by gravity. In order to do away with recycling, washing with water was tried either after the solids have been separated or whilst they accumulate on the screen. The latter technique is preferable from the point of view of oil recovery but it dilutes the crude oil and this is sometimes undesirable.

As an example, the composition of the solids is given in table 53. They were obtained from screening wet process crude oil through a 20 mesh strainer vibrating at 3000 rpm.

Table 53

Composition of the solids retained on the vibrating screen

	Unwashed solids	Washed solids
Water of solids	74.0%	82.3%
Oil on solids	16.6%	6.7%