QUICK AND ACCURATE METHOD TO STUDY DEMULSIFICATION

Oil

Comparison of different demulsifiers

INTRODUCTION

The effectiveness of a demulsifier depends on many parameters including the amount of water produced, the quality of the oil/water interface, the quality of the water produced and the separation kinetics. The usual technique used to evaluate the effectiveness of a demulsifier is the Bottle Test. In this Application Note, we propose a faster and more accurate technique to assess the quality of a demulsification and to compare the efficiency of different demulsifiers.

METHOD

The effectiveness of 5 different demulsifiers is assessed with a quick and simple protocol: 100 ppm of demulsifier (dosed from a stock solution using an appropriate solvent) is added to the crude oil emulsion and handshaked 50 times. The crude oil emulsion evaluated was from a UK onshore source with an API of 11° and a BS&W of 60%. All testing was carried out by Croda using demulsifiers from their Kemelix™ product range.

Demulsifier 1	**Polysorbate polyester**
Demulsifier 2	**Resin alkoxylate**
Demulsifier 3	**Resin alkoxylate**
Demulsifier 4	**Polyol alkoxylate**
Demulsifier 5	**Polyimine derivative**

Then, Turbiscan® measurements are performed at 60°C for 60 minutes with 1 scan per minute. The following graph displays a typical Turbiscan profile obtained.

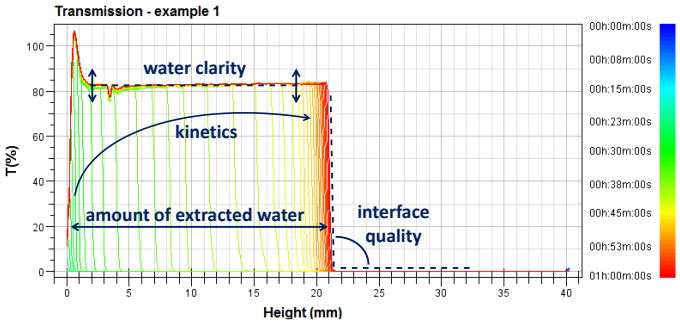


Figure 1: Evolution of the transmission signal for Demulsifier 1

RESULTS

The graph displayed in Figure 1 shows information regarding the **amount of produced water**, the **clarity** of produced water, the **quality of water/oil interface** and the **demulsification kinetics**.

Volume of water produced

The volume of produced water is directly linked to the thickness of the transmission peak obtained. The following graph displays the transmission peak thickness obtained for the 5 demulsifiers evaluated:

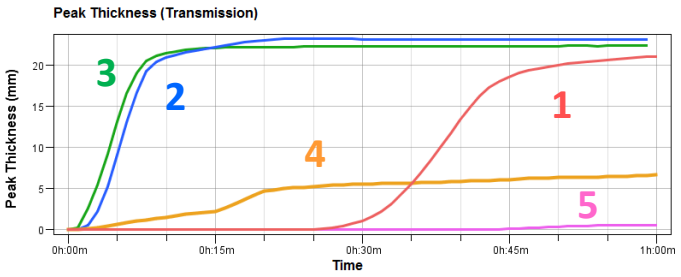


Figure 2: Peak thickness for the 5 demulsifiers evaluated

This graph allows us to classify these demulsifiers in terms of amount of produced water (initial volume of sample is 20 ml):

Sample	Final peak thickness (mm)	Amount of water produced (ml)	Amount of water produced (% of BS&W)
Demulsifier 5	0.6	0.3	<1
Demulsifier 4	6.6	3.2	27
Demulsifier 1	21.0	10.3	86
Demulsifier 3	22.3	10.9	91
Demulsifier 2	23.1	11.3	94

WATER VOLUME
-
+

This table shows that Demulsifiers 4 and 5 give relatively low amounts of produced water. On the other hand, Demulsifiers 1, 2 and 3 give comparable and significant amount of water produced.

Separation kinetics

Another important parameter in the demulsification process is the time required to complete demulsification. If we look again at Figure 2, Demulsifiers 1, 2 and 3 can be compared in terms of

separation kinetics (4 and 5 gave incomplete or no demulsification so were not considered for this analysis).

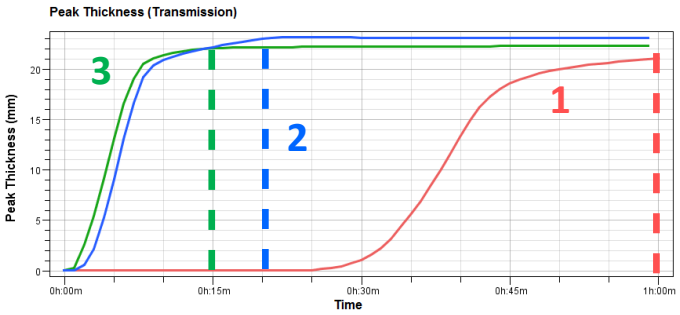


Figure 3: Peak thickness for Demulsifiers 1, 2 and 3.

Sample	Start time (min)	End time (min)
Demulsifier 3	0	15
Demulsifier 2	1	20
Demulsifier 1	24	>60

SPEED + ↓ -

These results shows that Demulsifiers 2 and 3 lead to a fast demulsification, whereas Demulsifier 1 gives a slower demulsification.

Clarity of water produced

The clarity of water produced can also be evaluated by assessing the transmission level of the water phase at the end of the measurement.

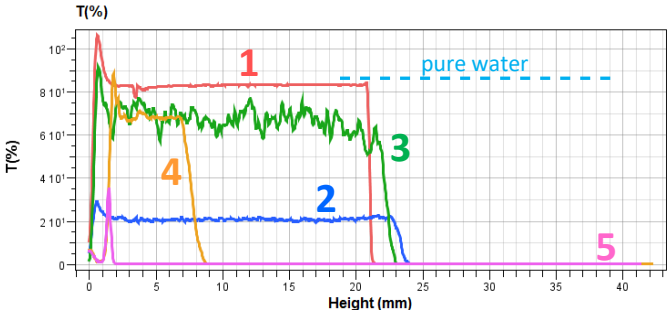


Figure 4: Transmission level at the end of the measurement.

Considering that the transmission level of pure water is 88%, the ratio between the final transmission level and the transmission level of pure water can be calculated, giving an index from 0 to 1, 1 being the best water clarity.

Sample	Final transmission level (%)	Turbiscan water clarity index
Demulsifier 5	0	0
Demulsifier 2	20.5	0.23
Demulsifier 3	67.3	0.76
Demulsifier 4	68	0.77
Demulsifier 1	83	0.94

WATER CLARITY - ↓ +

This table shows that Demulsifier 1 gives the highest clarity index, meaning the best produced water quality.

It is interesting to note that Demulsifier 4 leads to a high clarity index, but with a very low amount of water produced. Demulsifier 3 also leads to a high clarity index, but the transmission scan is very noisy, meaning that the produced water is contaminated with small oil droplets or inorganic salts.

Quality of the oil/water interface

Finally, Figure 4 gives additional information about the quality of the oil/water interface. This parameter can be assessed by calculating the slope of the last transmission scan at the oil/water interface. The sharper the slope, the better the interface quality (cf. Figure 4). The following table displays the value of this slope for Demulsifiers 1 to 4 (Demulsifier 5 was not included due to no demulsification taking place).

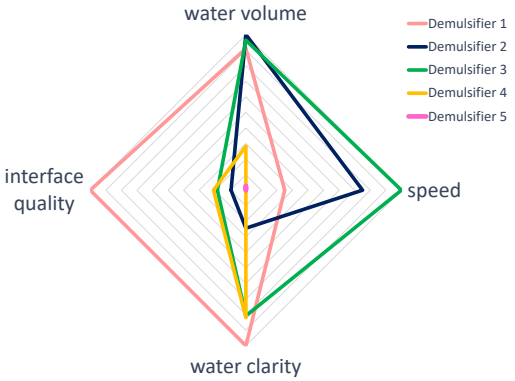
Sample	Slope (%/mm)
Demulsifier 2	-19
Demulsifier 3	-38
Demulsifier 4	-43
Demulsifier 1	-204

INTERFACE QUALITY - ↓ +

This table shows that Demulsifier 1 has the highest slope, meaning the best interface quality (i.e. most defined oil/water interface). Other demulsifiers lead to similar slope values, much lower than Demulsifier 1.

SUMMARY

This Application Notes shows a quick and simple method to compare the effectiveness of different demulsifiers **in only 60 minutes*.** The following graph summarizes the results obtained.



Demulsifiers 1 and 3 display the best performance; Demulsifier 1 in terms of quality of separation (oil/water interface quality and clarity of produced water) and Demulsifier 3 in terms of separation kinetics and the volume of produced water.

**Measurement time can be longer if sample viscosity is higher than 300 cP at 60°C.*