

Demulsifiers



Kemelix™
Providing optimum performance
in production and refinery
processes

Cargill®

Production and refinery demulsifiers

Emulsion breaking is one of the most complex and situational aspects of oilfield chemistry. Stable emulsions encountered in oil production are normally composed of varying levels of water or brine dispersed in a continuous oil phase. These emulsions are stabilized by compounds occurring naturally in the crude. Certain types of operations in refinery practice can also produce stable emulsions.

Our Kemelix™ range of demulsifiers facilitate the economical removal of water from crude, by utilizing a wide range of chemistries including resin alkoxyates, polyimine derivatives and modified polyols. When formulated, these products are capable of treating a wide range of emulsions under the most demanding field conditions; short residence times, high turbulence, high solids loading and high water content.

Treatment programs featuring Kemelix demulsifiers offer the following benefits:

- Outstanding performance in heavy oil applications
- Reduced treating costs & smoother operation
- Excellent low temperature performance
- Improved downstream operations
- Drier oil, cleaner water and sharper interface
- A superior environmental profile

Function guide

The components of a demulsifier formulation can be characterized according to their primary function; droppers or treaters. In addition, some components may also function effectively in other aspects of the performance requirements and certain compounds can provide a multi-purpose hybrid function in a particular crude oil (Fig. 1).

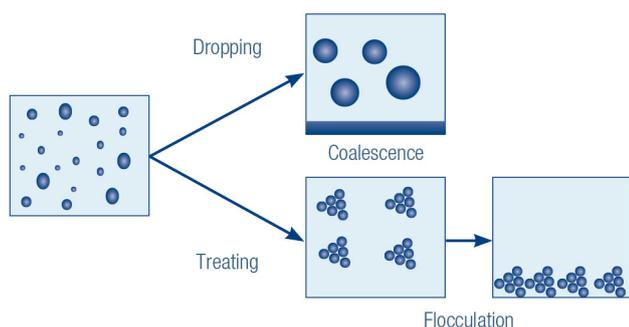


Figure 1: Demulsifier mechanisms

Droppers

The primary function of these compounds is to coalesce water droplets and release free water (Fig. 2). This class of demulsifiers also show excellent desalting properties. Kemelix droppers are specifically designed to treat heavy crude oil with great efficiency and are selected based on experience and performance for those crude types that are typically challenging to treat.

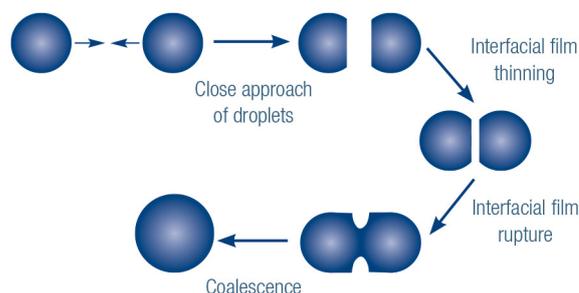


Figure 2: Process of coalescence

Treaters

The primary function of these compounds is to flocculate the large number of sub-micron water droplets dispersed in the crude oil (Fig. 3). Water droplets are concentrated at the base of the oil column prior to coalescence and the crude oil is dehydrated above the settling level of the flocculated water droplets. This is noticeable by a brightening of the top oil. Kemelix treaters are typically based on high molecular weight polymeric molecules with hydrophilic 'tips' which solvate into the water droplets and facilitate 'gathering'.

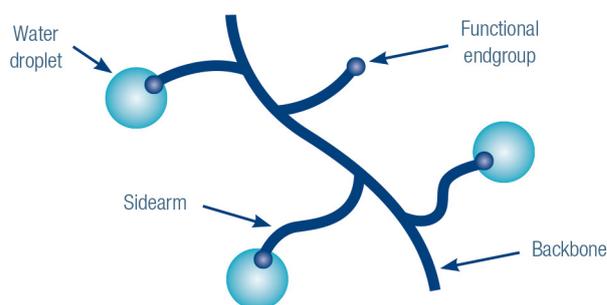


Figure 3: Structure of a Kemelix flocculator

Hybrids

These compounds incorporate a balance of molecular design features such that both dropper and treater characteristics are exhibited. For certain applications, hybrids may prove more effective than blends of droppers and treaters.

Refinery desalters

Crude oil desalting is one of the most critical steps in the refining process. Typically, emulsions to be desalted have low amounts of water and are less stable due to some of the naturally occurring emulsion stabilizers having been removed at the original demulsification stage. Our unique range of Kemelix desalters have proven through experience to achieve rapid water separation at low addition rates and have the versatility to cope with frequent changes of crude of different origin.

Relative Solubility Number (RSN)

The RSN test method determines the hydrophile-lipophile balance of the demulsifier under test by means of a water titration. The RSN is the volume of water (in millilitres) necessary to produce a persistent turbidity in the given solvent system. We have developed a novel method for determining the RSN of a demulsifier, which offers substantial reductions in the risks to health, safety and the environment that was inherent in historic tests. Historic tests typically involved hazardous solutions of benzene and 1,4-dioxane where the novel method utilizes a solution of dimethylisosorbide (75%), butyl diglycol (20%) and xylene (5%). Results generated from the novel method are directly comparable to those generated by the historical method.

All values quoted are determined with a solvent stripped demulsifier. In general, products with an RSN <13 are insoluble in water, products with an RSN 13-17 are water dispersible and products with an RSN >17 are soluble in water.

Kemelix demulsifiers are suitable to be blended with other components in order to achieve an optimal demulsification performance. Often final demulsifier formulations have an RSN between 8 and 15 and the synergistic effects of blends between different Cargill demulsifiers chemistries offer performance benefits to using single components.

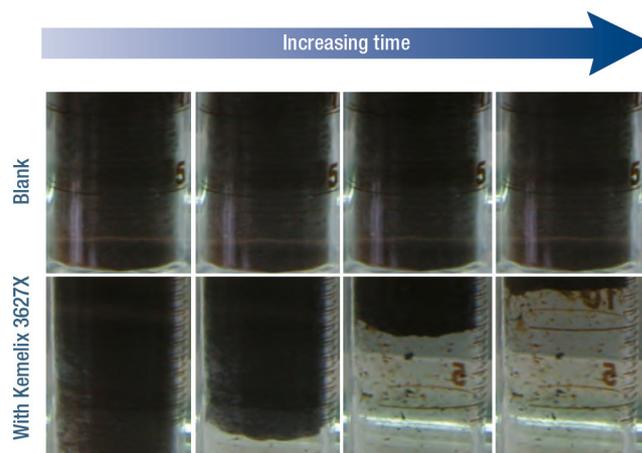


Figure 4: Crude oil with and without Kemelix 3627X demulsifier



Demulsifier guide tables

Kemelix is an extensive range of demulsifiers which are available to the production technologist, and where possible all of the available products should be tested and formulated accordingly. There will be circumstances, where for certain reasons (e.g. time constraints) it may not be possible to screen every single active component. Therefore we have broken down our product list to suggest recommended demulsifiers for certain field requirements. Whilst every set of conditions cannot be covered in this guide, the following tables give an indication of the first products to test in each instance.

Formulation recommendations

Resin alkoxyates and polyimine derivatives should be individually evaluated and then the best performing of these products should be combined. Optimized performance can then be achieved by adding Kemelix modified polyols or other products from the range.

Solubility details can be found in the demulsifier function guide at the end of this brochure for use when formulating with solvents.

Formulation Guide

- 25-35% Resin alkoxyates
- 5-10% Polyimine derivatives
- 10-20% Modified polyols
- 50% Solvent

First choice demulsifiers

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3515X	100	10				●
Kemelix 3627X	80	10	●			
Kemelix D311	80	17			●	●
Kemelix D501	100	20				●
Kemelix D510	100	12		●		●

First choice demulsifiers for heavy oils (API <20)

Heavy oil regions are becoming increasingly attractive but present unique challenges in production, stimulation, transport and refining compared to lighter crudes. To support our customers in these challenges, we have developed a specific range of demulsifiers optimized for their performance with heavier crude oils.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3515X	100	10				●
Kemelix 3627X	80	10	●			
Kemelix 3750X	80	20	●			
Kemelix D310	88	17	●		●	
Kemelix D322	80	16	●		●	
Kemelix D511	100	17			●	●

First choice demulsifiers for light oils (API >30)

The changing properties of oil recovered from one location to the next provide a challenge to service companies all over the world. For areas where the crude oil is lighter, we have developed a range of high performance demulsifiers which provide fast separation and a sharp interface.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3515X	100	10				●
Kemelix D309	80	21	●		●	
Kemelix D310	88	17	●		●	
Kemelix D311	80	17			●	●
Kemelix D400	80	7				●
Kemelix D501	100	20				●
Kemelix D510	100	12		●	●	

First choice demulsifiers for low temperature (<30°C)

More extreme locations present a challenge for oil recovery, where temperatures can be significantly below 0°C. Within the Kemelix range, we have demulsifiers which remain high performing at low temperatures.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3216X	88	9		●		
Kemelix 3422X	100	7		●		
Kemelix D104	100	14		●		
Kemelix D317	80	9				●
Kemelix D400	80	7				●
Kemelix D513	100	7		●		

First choice desalters

Crude oil desalting is one of the most critical steps in the refining process. Salt present in crude oil can cause significant problems such as corrosion, catalyst poisoning and fouling. Our desalters within the Kemelix range provide excellent desalting performance in refinery operations.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3678X	86	19	●		●	
Kemelix D309	80	21	●		●	
Kemelix D311	80	17			●	●
Kemelix D510	100	12		●	●	
Kemelix D511	100	17			●	●

First choice dehazers

Residual water in refined hydrocarbons can create a haze, which can go on to cause microbial activity or corrosion. To combat this, we have developed a superior range of dehazers that can be added to oil to cause rapid coalescence of residual water, improving settling time and allowing cleaner separations. The high performance dehazers will save time and money, preventing unnecessary filtering or reprocessing.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix D309	80	21	●		●	
Kemelix D310	88	17	●		●	
Kemelix D317	80	9				●
Kemelix D400	80	7				●
Kemelix D510	100	12		●	●	

First choice deoilers

To help customers remain compliant with permits and meet process requirements, deoilers can be used to polish effluent and remove emulsified oil.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3216X	88	9		●		
Kemelix 3515X	100	10				●
Kemelix D317	80	9				●
Kemelix D511	100	17			●	●

First choice for low water cut (<40%)

The water cut of crude oil can differ depending on various factors, and the demulsifier used is very much dependent on the condition of the crude oil. Within the Kemelix range we have several of demulsifiers which work especially well in crude oil with a low water cut.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3627X	80	10	●			
Kemelix 3678X	86	19	●		●	
Kemelix D309	80	21	●		●	
Kemelix D310	88	17	●		●	
Kemelix D322	80	16	●		●	
Kemelix D511	100	17			●	●

First choice for high water cut (>40%)

As oil reserves diminish and new techniques are used to recover the crude oil, the percentage of water within the crude oil is increasing. We have a range of demulsifiers which are capable of demulsifying a crude oil emulsion which has a high overall water cut.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3515X	100	10				●
Kemelix 3627X	80	10	●			
Kemelix D104	100	14		●		
Kemelix D309	80	21	●		●	
Kemelix D311	80	17			●	●
Kemelix D317	80	9				●
Kemelix D400	80	7				●
Kemelix D501	100	20				●

First choice for waste oil treatment

Waste oil streams are produced by several production and refinery operations, and it is often challenging to recover oil without disruption. Understanding that maximizing oil recovery whilst keeping costs low is important to our customers, we have engineered a broad range of waste oil treatment chemicals that can be tailored to your particular conditions. Incorporating Kemelix products into your formulations can provide a highly efficient treatment, allowing you to produce clean oil for recovery and high quality effluent water in a cost-effective way.

Demulsifier	Activity (%)	RSN	Primary function			
			Dropper	Treater	Desalter	Hybrid
Kemelix 3515X	100	10				●
Kemelix D317	80	9				●
Kemelix D400	80	7				●
Kemelix D501	100	20				●
Kemelix D503	100	20				●
Kemelix D511	100	17			●	●



In-house capabilities

Combining our state of the art facility in Houston in the USA and the expertise of our technical team, we are able to help find solutions to specific demulsification challenges.

A portfolio of best in class, high activity demulsifiers, the Kemelix range are suitable for use in a wide range of conditions. They have been developed using our in-house expertise and the results of a fundamental structure versus performance relationship determined through laboratory analysis of these molecules.

If a demulsifier has been poorly selected then it will not perform in field applications. Typical problems associated with poor selection include; poor water separation, emulsion build up at the water/oil interface, high water cut in the treated oil or oily water as well as increased costs. We are keen to work with you and offer you a bespoke solution specific to your crude, to optimize the performance and efficiency of your demulsification process.

Demulsibility testing

Demulsification performance testing is carried out using the same principals as a bottle test on a range of crude oils with differing parameters. Several parameters can be determined by observing transmission through the sample over time. These parameters are the speed of demulsification, amount of water released in comparison to the crude oil's BS&W, clarity of the produced water and quality of the oil-water interface.

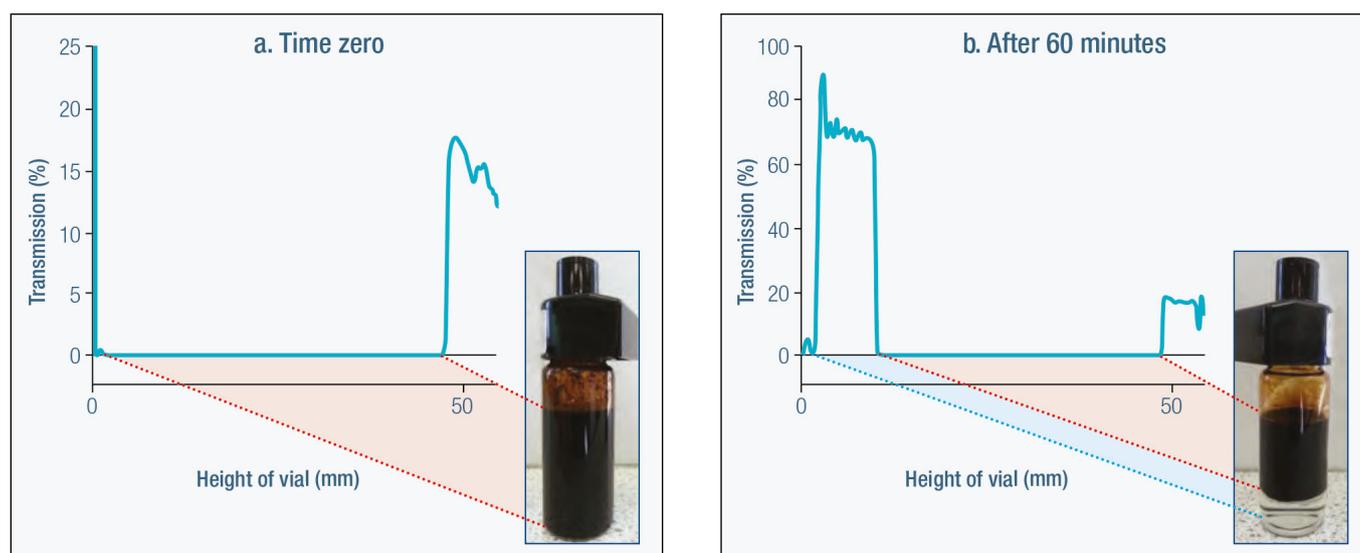


Figure 5: Test vials and graphical representation of demulsification

Interpreting the data

Figure 7 shows transmission against height of the cell containing the crude oil. At time zero (Fig 7a) there is no transmission through the crude oil emulsion. Once demulsification has occurred, the bottom of the vial becomes transparent (Fig 7b) and transmission occurs through the bottom of the vial. The percentage water out may be calculated from the position of the oil-water interface relative to the top and bottom of the sample. The interface quality may be observed from the verticality and smoothness of the joining line between no transmission (crude oil) and transmission (water). The water clarity may be observed from the transmission of the produced water.

Demulsifier function guide

Chemical description	Demulsifier	Appearance	Activity (%)	RSN	Solubility at 10%		
					Deionized Water	Isopropanol	Kerosene
Resin Alkoxyate	Kemelix 3501X	Amber liquid	80	16	Dispersible	Soluble	Insoluble
	Kemelix 3627X	Dark brown / amber liquid	80	10	Insoluble	Soluble	Insoluble
	Kemelix 3678X	Dark brown liquid	86	19	Dispersible	Soluble	Insoluble
	Kemelix 3750X	Dark brown / amber liquid	80	20	Soluble	Soluble	Insoluble
	Kemelix D309	Amber liquid	80	21	Soluble	Soluble	Insoluble
	Kemelix D310	Amber liquid	88	17	Dispersible	Soluble	Insoluble
	Kemelix D311	Yellow liquid	80	17	Dispersible	Soluble	Insoluble
	Kemelix D322	Amber liquid	80	16	Insoluble	Soluble	Insoluble
Polyimine derivative	Kemelix 3216X	Yellow liquid	88	9	Dispersible	Soluble	Insoluble
	Kemelix 3422X	Yellow liquid	100	7	Insoluble	Soluble	Insoluble
	Kemelix 3515X	Pale yellow liquid	100	10	Insoluble	Soluble	Insoluble
	Kemelix 3551X	Pale yellow liquid	100	10	Insoluble	Soluble	Insoluble
	Kemelix D510	Pale yellow liquid	100	12	Insoluble	Soluble	Insoluble
	Kemelix D513	Yellow liquid	100	7	Insoluble	Soluble	Insoluble
Modified polyol	Kemelix D104	Yellow liquid	100	14	Soluble	Soluble	Insoluble
	Kemelix D317	Yellow liquid	80	9	Insoluble	Soluble	Insoluble
	Kemelix D400	Yellow liquid	80	7	Insoluble	Soluble	Insoluble
	Kemelix D501	Colorless liquid	100	20	Soluble	Soluble	Insoluble
	Kemelix D503	Colorless liquid	100	20	Soluble	Soluble	Insoluble
	Kemelix D506	Colorless liquid	100	10	Dispersible	Soluble	Insoluble
	Kemelix D511	Colorless liquid	100	17	Soluble	Dispersible	Insoluble

		Pour point (°C)	Viscosity at 25°C (cP)	BTEX free	Primary function				Registration		
Aromatic Solvent	Hydrochloric acid (15%)				Dropper	Treater	Desalter	Hybrid	EU	USA	Canada
Soluble	Insoluble	-24	1600		●		●		●	●	●
Soluble	Insoluble	12	>5000		●				●	●	
Soluble	Insoluble	-24	2300		●		●		●	●	●
Insoluble	Dispersible	-30	1000		●				●	●	●
Soluble	Insoluble	-27	1400		●		●		●	●	●
Soluble	Soluble	-33	800		●		●		●	●	●
Soluble	Dispersible	-39	400		●		●	●	●	●	●
Soluble	Insoluble	-15	5900		●		●		●	●	●
Dispersible	Soluble	-33	1400	●		●			●	●	
Dispersible	Soluble	-27	3900	●		●					●
Dispersible	Soluble	12	4100	●			●		●	●	●
Dispersible	Soluble	3	4400	●		●			●	●	●
Dispersible	Soluble	-3	1900	●		●	●		●	●	●
Soluble	Soluble	-30	2800	●		●			●	●	●
Soluble	Insoluble	-30	1800	●		●			●	●	●
Soluble	Insoluble	-27	1900					●	●	●	
Dispersible	Insoluble	-45	900					●	●	●	●
Soluble	Soluble	1	800	●				●	●	●	●
Soluble	Soluble	9	1100	●				●	●	●	●
Soluble	Soluble	-9	900					●	●	●	●
Soluble	Soluble	3	1100	●			●	●	●	●	●



Who are we?

The Energy Technologies business in Cargill Bioindustrial creates, makes and sells specialty chemicals and additives for the global energy market. Working in close collaboration with our customers, we apply sustainable concepts and deep scientific expertise so that together we can efficiently power the world of tomorrow.

At our core, we are experts in synthetic ester and polyalkylene glycol chemistries, taking products from lab scale through to full manufacturing. Investing in the development of new chemistries allows us to support our customers in meeting new industry challenges.

For those who dare to imagine a brighter future, we establish long lasting relationships and create bespoke industry solutions through our integrated research & development and global manufacturing capabilities. Being both global and local, you have direct access to our network of technical experts. We look forward to talking to you.

Further information

Cargill Bioindustrial sales and distribution are coordinated through an extensive worldwide network of technical and commercial experts. For further information or guidance please contact us:

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