NAPHTEN

Naphthenate inhibitors

Additives
for oil production

Recherche
Exploitation
Produits

THE ORIGIN OF NAPHTHENATES

Naphthenic acids are made of a mixture of monocyclic, polycyclic and linear carboxylic acids. These active compounds are natural constituents of crude oil. The formation of naphthenate is linked to a mixture of crude with certain water production. Thus, when the pH exceeds the pKa of acids, they dissociate into volatile species that gradually migrate to the interface. They can then stabilize the emulsions (association with a monovalent cation, Na^+ for example) or form deposits that are extremely difficult to remove (together with a divalent cation, Ca^{2+} for example). The deposits of calcium naphthenates are insoluble in water and crude. Moreover, thanks to their properties, they will accumulate in the oil-water interface in the dividers to create highly viscous sludges.

Dissociation of naphthenic acids in naphthenate ions and H^+

MECHANISMS OF DEPOSIT FORMATION

One of the criticisms of naphthenate deposit formation corresponds to the migration of acids in their dissociated form $[R(COO^-)_4]$ to the oil-water interface, followed by their association with cations of water.
The dispersants of our NAPHTEN range have a strong interfacial activity: they are aligned at the interface, thus reducing the interaction between cations and organic acids without increasing the emulsifying power.

INTERFACIAL RHEOLOGY

The performance of the NAPHTEN range has been established by interfacial rheology, using a pendant drop tensiometer that measures the viscoelastic module to the interface, according to the following formula:

$$G^* = G' + iG''$$

With G' the elasticity module and G» the viscous module.

We observe high elasticity when the interactions between species at the interface are strong. G' is directly proportional to the number of bonds between the molecules involved in gel formation. In the presence of naphthenates, the value of G' will be important.

Pendant drop tensiometer

If the interface has an elastic behavior, synonymous with formation of a naphthenate gel, the drop will crease and reveal a rigid surface during the experiment. Conversely, if the surface of the drop remains fluid, the Naphten is then used to inhibit the deposit formation.

Drop of acid crude in water with a high Ca^{2+} content. Treated with a naphthenate inhibitor (left) and untreated (right)

PROVEN EFFICACY OF NAPHTEN 2

Among the products of **the NAPHTEN range proposed by REP, the NAPHTEN 2 (column E)** was evaluated by a partner university and compared to other references on the market.
It is the only one to completely and rapidly inhibit the formation of naphthenate gel at the interface.

Action of inhibitors on the formation of naphthenate gel
(TA) = 5ppm pH = 6.5 BSW = 25% (Inhib) = 200ppm Product E = Naphten 2

HOW TO CLEAN THE DEPOSITS?

The NAPHTEN inhibitors may also be used once the deposit is already formed. Many laboratory studies have demonstrated the capacity of inhibitors to dissociate naphthenates deposits in moving the acid species of the oil/water interface without acidification.
The NAPHTEN products, as naphthenic acids, are distributed between the oil, water, and interface phase according to the pH of the system. The migration of the inhibitor to the water phase becomes significant with the increase of pH without losing performance.
Until reaching pH=8, our inhibitors reduce 3 to 4 times the migration of acids from the oil phase.

Migration of naphthenic acids to water phase

20 ppm Tetra-Acids (synthetic), Toluene,
(active 200 ppm)
200 ppm Ca2+, 100 ppm HCO3-, pH 8.0

NAPHTEN RANGE: PRODUCTS AND FEATURES

Products	Composition	Density at 20°C	Viscosity at 20°C (cps)	Application
NAPHTEN 2	Ester	1.05	22	Inhibitor of Ca^{2+} naphthenates and Na^{+}
NAPHTEN 2C	Concentrated ester	1.05	46	Naphthenate dispersant
NAPHTEN 3	Blend of surfactants	1.05	25	Inhibitor of Ca^{2+} naphthenates and Na^{+}
NAPHTEN 4	Ether of alkoxylated phosphate	1.05	32	Naphthenate inhibitor of Ca^{2+} high performances
NAPHTEN 9	Proprietary blend	1.06	29	Naphthenates inhibitor and paraffin dispersant

For all products, the flash points are above 61°C (closed cup).

Environment

In the field of oil production, REP products, developed in strict compliance with European standards, provide maximum safety, hygiene and prevention.

Packaging

REP products intended for use on site are available in a wide range of containers, notably including 215-liter drums and IBC totes of 1000 liters.

For further information about the NAPHTEN Range or to receive a sample, please contact us on +33 (0) 1 30 98 80 00 or at info@rep.fr.

REP is represented in your market by:

REP is available worldwide through its subsidiaries and distributors. For more information, please contact REP at the following address:

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REP: SUSTAINABLE SOLUTIONS IN THE SERVICE OF **MANKIND**, **PRODUCTION** AND THE **ENVIRONMENT**.

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