

A microscopic view of numerous orange, needle-like or plate-like crystalline structures scattered across a dark, textured background. The crystals vary in size and orientation, creating a complex, layered appearance.

Global Oilfield Chemicals

Basoflux® – Paraffin Control
for the Oil Industry

 **BASF**

We create chemistry

Basoflux[®] products are highly effective and an economic solution for the mitigation of paraffin issues

BASF has designed a wide range of high-performance products, Basoflux[®] grades, which help you to mitigate paraffin deposits and can significantly lower the pour point of your paraffinic crude.

Introduction

Generally, wax control agents should have a wide performance range, but due to the various origins and compositions of crude oils this target is difficult to achieve. Therefore it is common practice for the most effective additives to be developed individually for each crude oil or residue. Many different polymer systems have been synthesized over recent decades, but only a few of them were found to be effective wax control agents. In recent time BASF has developed three new classes as part of their Basoflux[®] grades.

Function guide

For polymers to be effective wax control agents, their molecular structure must contain 'paraffinic chains' to allow them to interact with paraffins. They can be characterized by their function in solving wax related issues. It should also be noted that several Basoflux[®] products may display multiple functions depending on the nature of the crude oil.

Pour point depressants

Additives which reduce the pour point of crude oils are known as pour point depressants (PPDs) or flow improvers. Upon cooling, wax separates out as plate-like crystals or needles. These crystals interact to form a three-dimensional network in which the crude oil is trapped, resulting in increased viscosity or even solidification of the bulk oil phase. PPDs affect the crystallization process and prevent the formation of such three-dimensional networks, thereby reducing the pour point.

Wax inhibitors

Chemicals that affect the amount of wax which is deposited in e. g. cold-finger tests or in a coaxial-shear cell test are usually referred to as wax inhibitors. In some cases, the wax appearance temperature (WAT) or the cloud point is also affected. Wax inhibitors generally influence the crystal morphology, creating weaker deposits which are more easily removed by shear forces within the flowing crude.

Dispersants

Wax dispersants can reduce the amount of wax deposits in flow-lines by different mechanisms depending on their chemical nature. Some will adsorb to pipeline surfaces thereby changing the wettability to water-wet. Others will adsorb to growing wax crystal surfaces reducing the tendency of the crystals to agglomerate. Most of the dispersants are typical surfactant structures but some polymeric wax control additives also display dispersing activity. A paraffin dispersant test kit based on surfactants is available through your local sales representative.



Basoflux® Product Line Overview

The current Basoflux® product line is designed to support the Oilfield Service Industry to meet their customer's expectation on reliable flow assurance. BASF continuously invests in improving this offering and now we are able to introduce a range of new products to complement our existing Paraffin Control portfolio.

Basoflux® PI 1019 and PI 1020

- Two new and very novel hyperbranched polyester products with varying modified carbon chains.
- Applied as stand-alone products, or in great synergy with other Basoflux® grades, these hyperbranched products perform exceptionally well.

Basoflux® PI 3119 and PI 3120

- Two poly acrylate products that complement all other Basoflux® grades.

Basoflux® PI 40, PI 41 and PI 45

- PI 40 and PI 41 are two legacy products that continue to perform excellent mainly as deposition preventors in a wide array of crude oils.
- PI 45 is a new and novel development that has a much broader carbon chain distribution and therefore inhibits a broader range of paraffins.

Basoflux® RD 5119T and RD 5120T

- Two legacy products that continue to perform excellent as PPD's or deposition prevention in a wide array of crude oils.
- Both products do not contain toluene and the solvent is naphthalene-depleted, this assures access to markets where toluene is regulated and cannot be imported.
- Both products have a higher flash point than toluene or xylene, this provides easier handling, re-packing, blending and handling in general will be less hazardous.

Basoflux® PI 6320

- A new and novel dispersion product based on our PI 3120 Poly Acrylate.
- The micelle particles are 100–150 nm resulting in a very thermally stable product.
- This product is winterized till minus 20 °C and can be further winterized till below minus 40 °C by adding glycol.
- Application for sub sea umbilical can be considered.

(b) With BASF products present

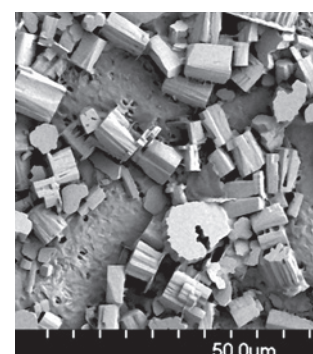
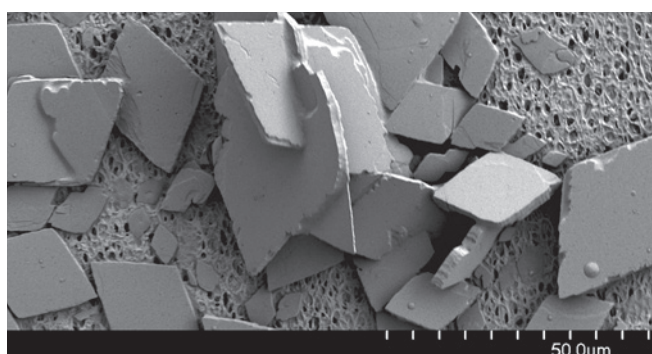


Fig. 1. (a) Sample of paraffin crystals without inhibition

Product	Form	Chemistry	Active content (%)	Melting point (°C)	Application		
					Wax inhibitor	PPD	Yield stress improver
PI 1019	liquid	Hyperbranched Polyester	50	15	••	••	•••
PI 1020	waxy	Hyperbranched Polyester	50	30	••	••	•••
PI 3119	waxy to liquid	Poly Acrylate	50	25	•	••	•••
PI 3120	waxy solid	Poly Acrylate	50	37	•	••	•••
PI 40	waxy solid	Modified Poly Carboxylate	80	39	•••	••	•
PI 41	waxy solid	Modified Poly Carboxylate	80	39	•••	••	•
PI 45	waxy solid	Modified Poly Carboxylate	75	33	•••	••	•
RD 5119T	liquid to waxy	EVA-Acrylate Copolymer	50	17	•	•••	••
RD 5120T	waxy solid	EVA-Acrylate Copolymer	50	32	•	•••	••
PI 6320	liquid	Poly Acrylate Dispersion	34	n/a	•	••	•••

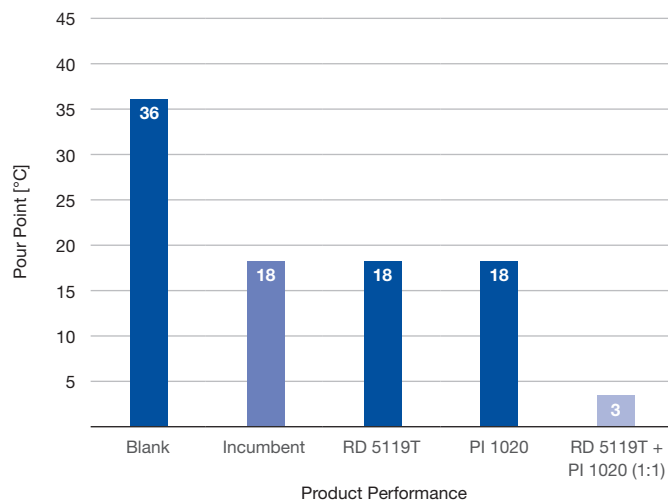
Initial recommendation

In order to study the efficiency of wax control agents in crude oils, the following parameters should be tested:

- Wax appearance temperature (WAT)
- Pour point
- Viscosity
- Rheology
- Paraffin deposition and prevention – Cold Finger
- Restartability of a model pipeline

It is highly recommended to dose all additives above the WAT to get reproducible and comparable results during pour point and wax deposition testing.

Field A – pour points results





Synergy

Basoflux® products, when blended together in a specific ratio, often demonstrate synergistic effects, i.e. the combined performance of two or more products is greater than the sum of the individual products. A few examples are provided below to illustrate this effect. BASF Subject Matter Experts can advise you during testing.

Example 1

- Crude oil has a blank pour point of 27 °C
- RD 5120T @ 1000 ppm reduces the pour point to 9 °C
- PI 41 @ 1000 ppm reduces the pour point to 9 °C
- RD 5120T + PI 41, ratio 1:1, @ 1000 ppm reduces the pour point to < -3 °C

Example 2

- Crude oil has a blank pour point of 36 °C
- RD 5119T @ 4000 ppm reduces the pour point to 18 °C
- DP PI 1020 @ 4000 ppm reduces the pour point to 18 °C
- RD 5119T + PI 1020, ratio 1:1, @ 4000 ppm reduces the pour point to < 3 °C

Example 3

- Deposition challenge
- Incumbent achieves 70% inhibition
- DP PI 1019 @ 1000 ppm, achieves ~70% inhibition
- DP PI 1020 @ 1000 ppm, achieves ~70% inhibition
- DP PI 1019 + DP PI 1020, ratio 1:1, @ 1000 ppm, achieves > 90% inhibition

Handling

Generally, BASF's polymers which are effective as wax crystal modifiers contain paraffinic chains in their molecular structure and thus will have a similar melting point. Our recommendation for handling the Basoflux® products is to utilize one of the following in order to remove the product from a drum.

1. Water bath: 70 °C for minimum 4 hours
2. Hot room: 40–50 °C for minimum of 12 hours
3. Heating jacket: 70 °C for minimum 4 hours

Our recommendation for handling the Basoflux® RD types is to only heat the product for +20 °C over the reported melting point. Exposure of Basoflux® grades to prolonged heat can cause product deterioration.

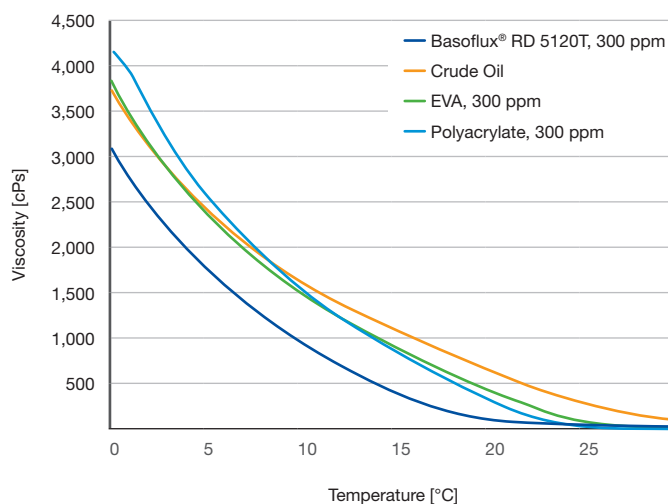
Innovation & Winterization

Innovation based on more sustainable, high-performing products to make our customers more successful, is at the heart of BASF's strategy.

The next generation Basoflux® products are currently being developed and will resemble the PI 6320 dispersion product allowing all Basoflux® grades to be blended as dispersions and benefit from the synergistic effects, yet the end formulation to be fully winterized to below -40 °C.

Evaluation of the rheology performance of the Basoflux® RD types in crude oil

Viscosity versus temperature



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