COPI™ Technology
Crude Oil
Paraffin Inhibitors

COPI™

EVONIK
POWER TO CREATE

COPI™ Technology

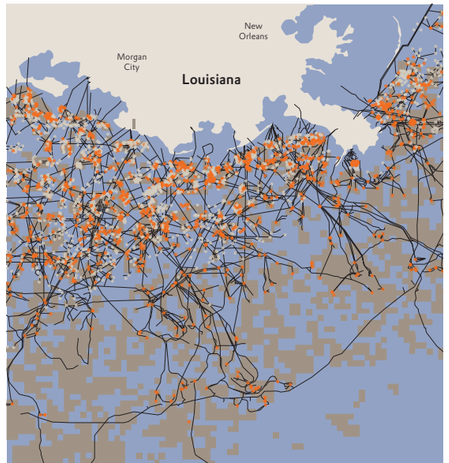
Crude oil is a very complex mixture of hydrocarbons. Some with very high paraffinic wax can create critical flow problems, even at ambient temperatures. This is due to high melting points and long-chain paraffin crystallizing at the cloud point or below. In general, there are three problems: increased viscosity, a higher pour point, and increasing wax deposition. A number of methodologies have been employed to fix the flow problem, such as using pigging, heating, solvent dilution, and a paraffin inhibitor. Depending on the specific conditions, one methodology or combination of several are used to achieve the most economical method to keep the crude oil flowing.

COPI™ technology has been developed by the Oil Additives specialists at Evonik to modify the size and the shape of the wax crystals, dispersing them and preventing them from adhering to pipeline or transporting vessel surfaces.

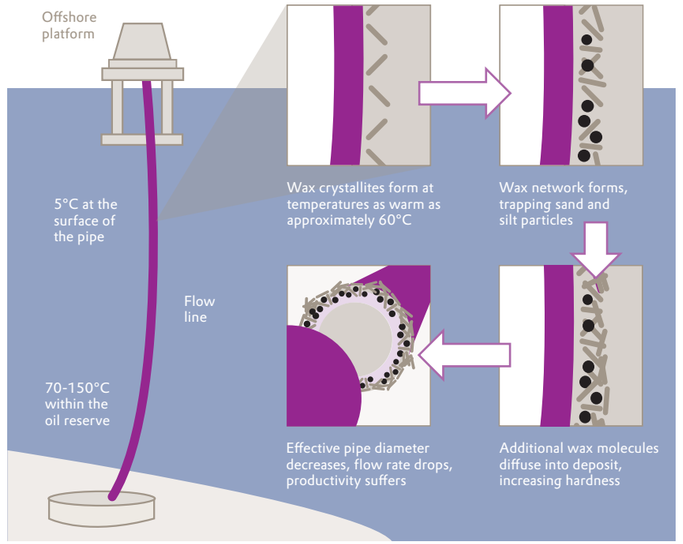
COPI™ provides important benefits in:

- Crude oil production
- Crude oil transportation
- Storage

Virtually all paraffinic mineral oil base stocks contain small amounts of waxy materials. As the temperature of the oil is decreased, some of the waxy components come out of solution as tiny crystals, and the solution begins to appear hazy to the naked eye. The temperature at which this occurs is called the **cloud point**. As additional wax precipitates, the crystals grow into plates and, finally, if the temperature is decreased far enough, the plates will grow together to form a three-dimensional network that totally immobilizes the oil. This solidification process is sometimes referred to as gelation. The lowest temperature at which the oil is fluid is called the **pour point**.

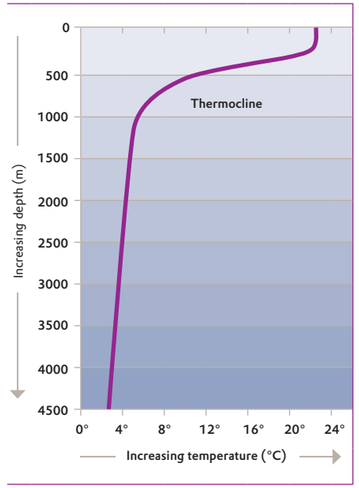


Wax deposition will occur on the cold surface of the pipeline



Wax molecules Sand and silt particles

Sea water temperature gradient



Without COPI™

Wax crystallites can start forming in crude oil at temperatures as warm as 60°C (140°F), as these temperatures are below the cloud point of wax. Due to the wax crystal formation, the crude oil becomes a non-Newtonian fluid. Its viscosity increases quickly when the temperature continues to drop during transport. Thus, productivity diminishes, increasing pump pressure, and eventually stopping flow due to wax solidification.

In deep water drilling, this problem is amplified many times over as the deeper the drilling, the colder the water surrounding the pipeline, leading to significantly more wax deposits.

At a depth of 1,000 meters (3,280 ft.), sea water is about 4°C (39°F). At this temperature, a wax network forms inside the pipeline, trapping sand and silt particles. Additional wax molecules attach, increasing deposition hardness and further narrowing the pipe diameter.

Decreased flow and lost productivity are expensive. Oil industry insiders cite one specific repair job that ran into hundreds of millions of dollars.

Analytical techniques for COPI™ technology

The effectiveness of COPI™ varies depending on the type of crude oil to which it's applied. To determine the most effective paraffin inhibitor, the Oil Additives specialists at Evonik conduct various analytical screening evaluations and employ techniques using state-of-the-art equipment.

Analytical screening techniques:

- Cloud point
- Pour point
- Differential scanning calorimeter
- Rheometer
- Brookfield cone and plate
- Cold finger

Evonik's paraffin inhibitor chemistry

To ensure crude oil flows efficiently, some state-of-the-art techniques are combined and used, such as heating and insulation, pigging, solvents, dispersants, hydrate inhibitors, asphaltene inhibitors and paraffin inhibitors.

Evonik's paraffin inhibitors are based mainly on polyalkyl methacrylate chemistry (PAMA). By varying the length of the PAMA molecule's alkyl side chains, Evonik tailors the structure-property relationship to modify wax crystal growth in crude oil.

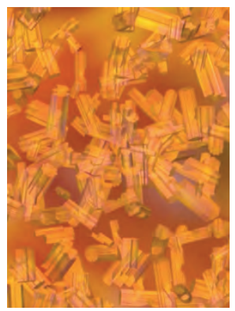
COPI™ prevents the interlocking of wax crystals, leading to smaller and more random structures. As a result, the crude oil continues to flow without the build-up of a wax network.

The technology behind Evonik's crude oil paraffin inhibitor

Without COPI™ technology

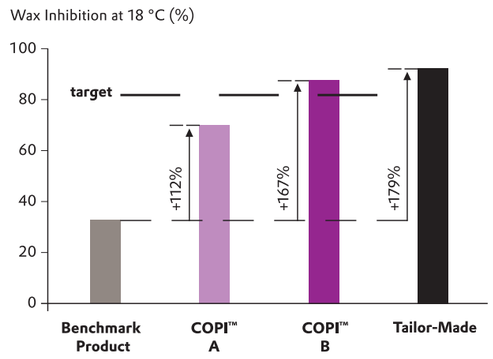
Densely structured wax formation

With COPI™ technology



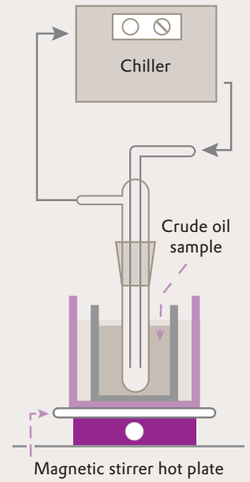
Randomly dispersed wax crystals

COLD FINGER TEST



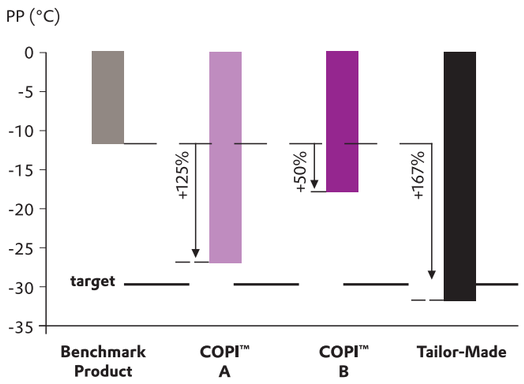
Cold finger analytical technique

Due to better correlation with field performance, "Cold finger" is the preferred screening method to identify an effective flow improver or paraffin inhibitor. In the graph to the left, three VISCOPLEX® products were tested by cold finger testing in one crude oil for six hours against the competition.



Test results

POUR POINT TEST



COPI™ product summary

PAMA	PAMA / EVA	Tailor-made
14-921	14-301	We will develop customized products to meet your specific needs.
14-924	14-302	
14-927	14-304	
14-928	14-401	
14-950	14-402	
14-951	14-900	
14-982		
14-983		

Figure 1: Wax deposit on cold finger surface.

COPI™ technology for environmentally-friendly applications

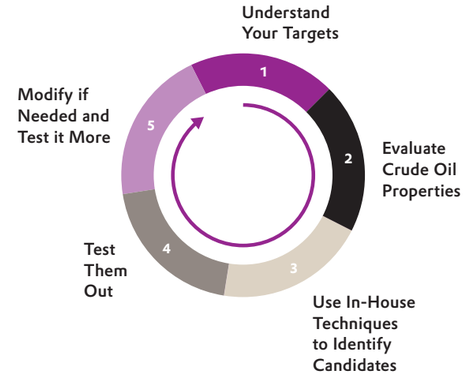
Demand for environmentally-friendly lubricants is growing due to environmental concerns and strict government regulations. Evonik can help address these concerns with COPI™ to meet rigorous environmental protection requirements.

Get an edge with Evonik

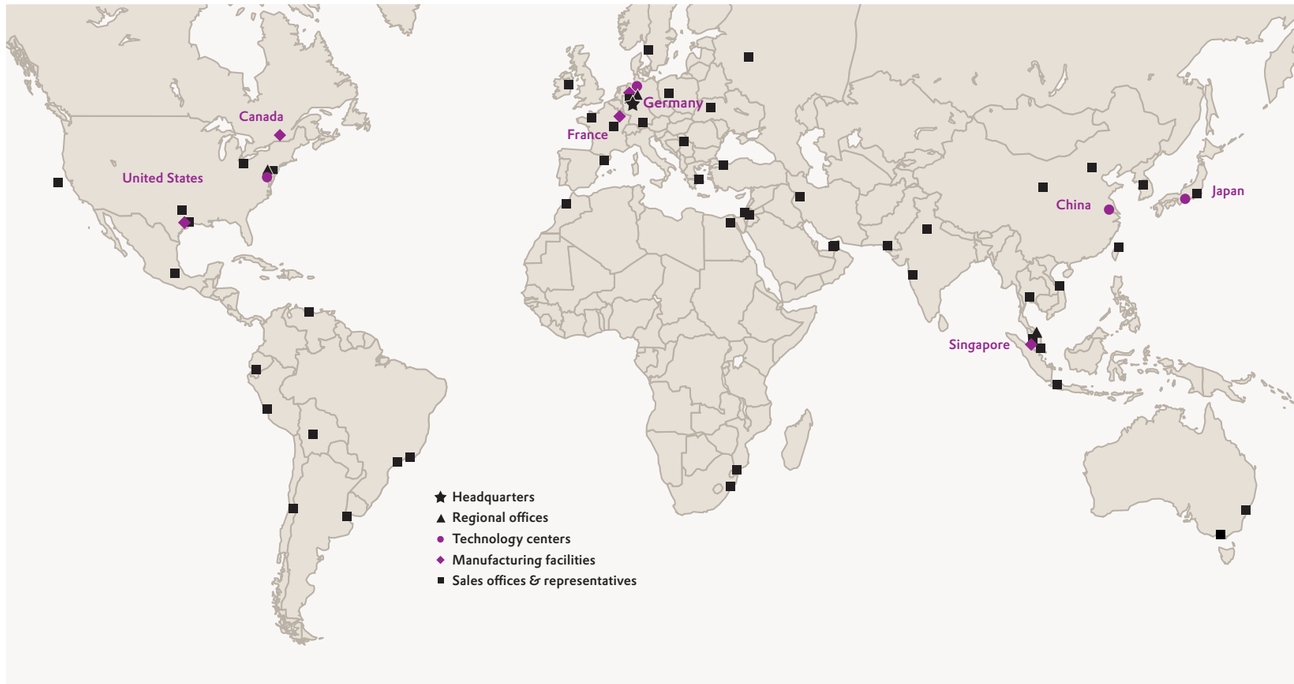
With plants in the US, Canada, Europe and Singapore, the Oil Additives specialists at Evonik create custom solutions using paraffin inhibitors to meet each customer's specific needs.

Evonik provides worldwide technical support and is engaged in continuous product development. Its innovative, tailor-made products give customers "an edge" in beating the competition, and helping them to "future-proof" their business against industry challenges.

How do we work with customers



To learn more, contact Evonik's Oil Additives specialists at oil-additives@evonik.com.



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