DOSAS

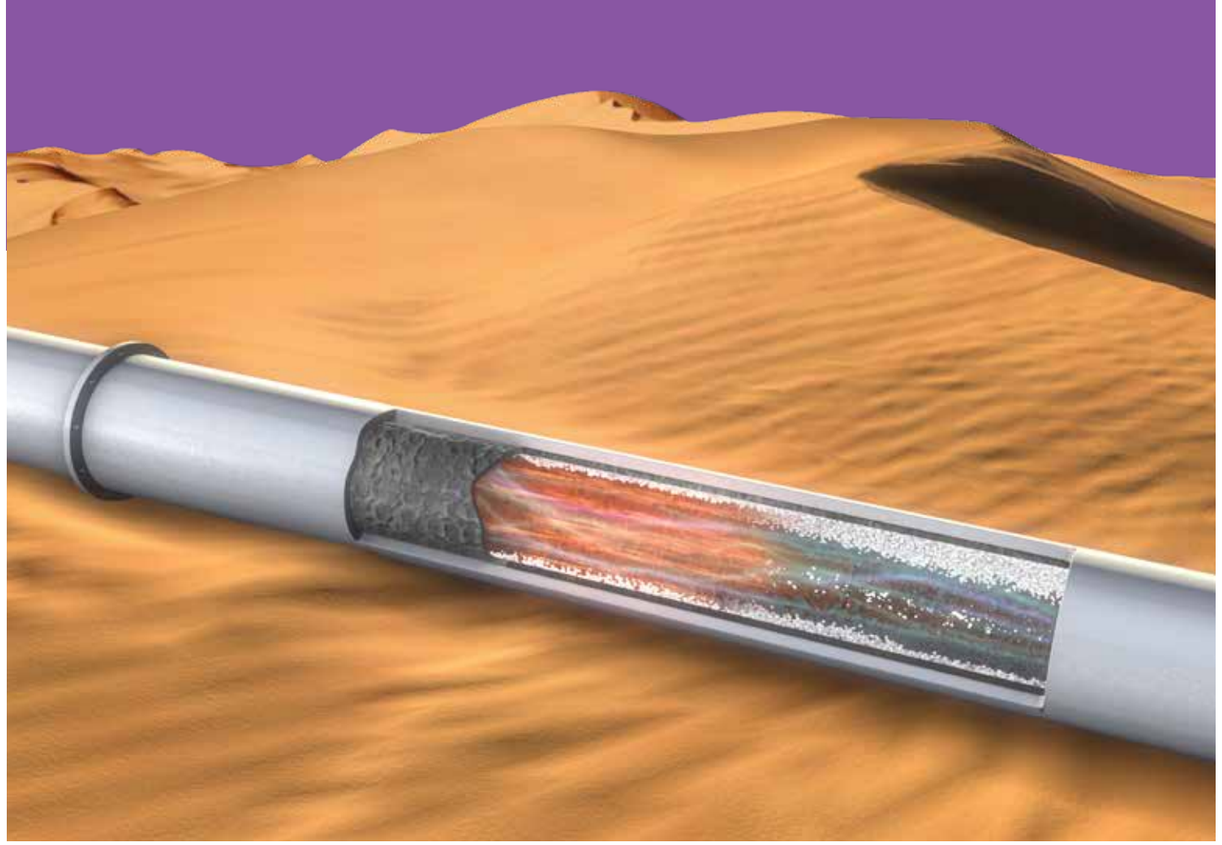
Production Chemicals

Antiscalants

PASSION TO INNOVATE | POWER TO CHANGE

Oilfield Scales

The formation of scales can have an extremely detrimental effect on hydrocarbon production. Scale precipitates are caused by a change of conditions in a production system containing the mixing of incompatible waters, a disturbance of formation water equilibriums and/or change in pressure and temperature. Any or a combination of these effects cause ordinarily soluble compounds, to precipitate as depositions in the production system, with devastating consequences and sometimes leading to a complete curtailing of production as fast as within a single day.



Most common oilfield scales

Calcite: Calcium Carbonate deposits mainly form due to decreasing pressure and increasing temperature.
Barite: Barium Sulphate scales normally occur due to the mixing of incompatible waters, where one water type, normally a formation water, contains barium ions and the other, a seawater type, contains sulphate ions.
Other scales include Anhydrite ($CaSO_4$), Celestite ($SrSO_4$), Gypsum ($CaSO_4.2H_2O$), Halite (NaCl), Pyrite (FeS_2) and Siderite ($FeCO_3$).

What Causes Scale?

Scale can be caused by any one or a combination of several changes in the production system:

- Pressure changes
- Temperature changes
- Impurities and Additives
- Variation of flow rates
- Changes in pH
- Fluid expansion
- Gas evaporation
- Mixing of incompatible waters

Challenges

What Damage Does Scale Cause?

The effect these scales have on a well depends largely on their location and the amount deposited in the system. Scales can restrict and completely choke production at the sand face, in the perforations, in downhole tubulars or surface flow lines. Scales can also deposit in formation or natural fractures that are distant from the wellbore.

What are the Economics of Scale?

The deposition of inorganic scale in producing wells is a costly problem in the oil industry. Stuck downhole pumps, plugged perforations and tubing strings, choked flow lines, frozen valves, equipment damage, and downtime during maintenance all contribute to cost. Scale restricts production and causes inefficiency and failure of production equipment. As fields mature and require water flood operations, the scale problems have even greater effect on well economics.
Scale disposal can be quite costly. The most economical way to manage wells that tend to scale is to use a solution to prevent the scale from forming. The savings are even more significant when scale prevention treatments are combined with stimulation treatments.

Predicting Scaling Issues

Scaling potential can be modelled using scale modelling software, which looks specifically at the ions present in various produced and/or injection waters, in conjunction with the changes along a production system, such as pressure and temperature, as produced fluids flow from reservoir to surface facilities. Software outputs predict the type and tendency of scale precipitation, though do not model the deposition at any point in the production system. Scale prediction software is an extremely useful tool, contributing to successful prevention of scaling issues.

Scale Control Mechanisms

Chemical Antiscalants work by the following different mechanisms:
Chelation – Sequestration of the ions that would cause scale to precipitate (e.g. calcium or barium), there after locking up the ions in a chelate compound and keeping them in solution to prevent precipitation.
Threshold Inhibition - The binding site of the scale solution molecule is attracted to the charges on even the smallest scale crystal, preventing the crystal from growing larger. Eventually the crystal re-dissolves and releases the solution to repeat the process.
Solid Inhibition - Solid product that slowly desorbs to provide immediate and long-term protection against scale deposition minimizing risks of lost production. As the well begins to produce, the inhibitor slowly and controllably desorbs in the aqueous phase, which inhibits scale deposition from the deepest fractures and into the wellbore. Because the solid inhibitor has been placed deeper inside the reservoir, it can deliver more effective and long-term protection during the productive life of the well.

Choosing a Solution

DOSAS carries a number of effective solutions, some with ultra-low corrosive characteristics, which are non-damaging to downhole tubulars and sensitive components found in downhole pumps. Our analytical approach to the selection of Antiscalants is based on understanding the scale type, scaling potential, location of scale and the specific conditions of the environment in which the precipitation occurs. A careful screening process is applied prior to any laboratory testing to confirm the application. Testing is always recommended to be carried out under the existing field conditions. A variety of chemical Antiscalants, or even a customised blend, may be required to provide the most economical treatment for a scaling problem.

						Application									
Group	Product	Chemical Nature	Form	Compatibility	pH Range	Anhydrite ($CaSO_4$)	Calcite ($CaCO_3$)	Barite ($BaSO_4$)	Celestite ($SrSO_4$)	Silica	Lead sulfide (PbS)	Halite (NaCl)	Iron	Zinc sulfide (ZnS)	Stability
Scale Inhibitor	DosTreat™ I-10	phosphate Ester	Liquid	with a variety of chemical treatment (Solvents, often synergistic with other SI's)	2.5 - 4.0	●	●	●	●						Optimum Thermal Stability at Low Temperature
	DosTreat™ I-20	Sulfonated Acrylate copolymer	Liquid	with a variety of chemical treatment (Solvents)	2-6	●	●	●	●		●			●	Optimum Thermal Stability at Ultra-High, Temperature and Pressure
	DosTreat™ I-30	Sulfonated Carboxylate Copolymer	Liquid	with a variety of chemical treatment	8		●	●				●			Optimum Thermal Stability
	DosTreat™ I-40	Sulfonated Styrene Copolymer	Dry	with a variety of chemical treatment (Ethylene Glycol)	5-9		●	●					●		Optimum Thermal Stability at ultra-high, temperature and Pressure
	DosTreat™ I-50	Polycarboxylic	Liquid	with a variety of chemical treatment	2-4	●	●	●	●						Optimum Thermal Stability
	DosTreat™ I-60	Acrylic Copolymer	Liquid	with a variety of chemical treatment	4.2	●	●	●	●	●					Optimum Thermal Stability
	DosTreat™ I-70	Polyaspartate Amine	Liquid	with a variety of chemical treatment	11	●		●	●						Optimum Thermal Stability at Low Temperature
	DosTreat™ SI-11	Phosphonate	Solid	with a variety of chemical treatment	2-6	●	●	●	●						Optimum Thermal Stability
	DosTreat™ SI-22	Polymeric	Solid	with a variety of chemical treatment	2-6	●	●	●	●						Excellent Thermal Stability
Scale Remover	DosTreat™ R-15	GLDA	Liquid	with a variety of chemical treatment	11-12	●	●								Optimum Thermal Stability AT Low Temperature
	DosTreat™ R-25	EDTA	Liquid	with a variety of chemical treatment	9								●		Optimum Thermal Stability
	DosTreat™ R-45	DTPA	Liquid	with a variety of chemical treatment	11	●	●	●	●						Optimum Thermal Stability

Testing for Performance of Antiscalants

DOSAS' laboratory technicians are experienced in all methods of testing related to oilfield scaling issues, from the analysis of scale itself, to various techniques for testing efficiency of our products, to developing customized blends for more challenging production environments. DOSAS laboratory is well equipped for evaluating the most effective solutions for efficient removal and inhibition of scale deposition.

X-Ray Diffraction

X-ray Diffraction (XRD) is a technique used in materials science for determining the atomic and molecular structure of a material. This is commonly used for characterizing scales as well as other oilfield samples.

Dynamic Tube Blocking Test

Dynamic "Tube Blocking" performance test (TBR), commonly used for scale solution selection in oilfield environments, partly examines the ability of Antiscalants to prevent adherence and growth within micro-bore coils and determine the minimal necessary solution concentration.

Static Bottle Tests

The static inhibition efficiency (IE) (%) is a measure of how effective an inhibition solution is at preventing scale formation under a specific set of experimental test conditions, i.e. temperature, pH, etc., and at a particular time after mixing the two incompatible brines.

Thermal Stability Test

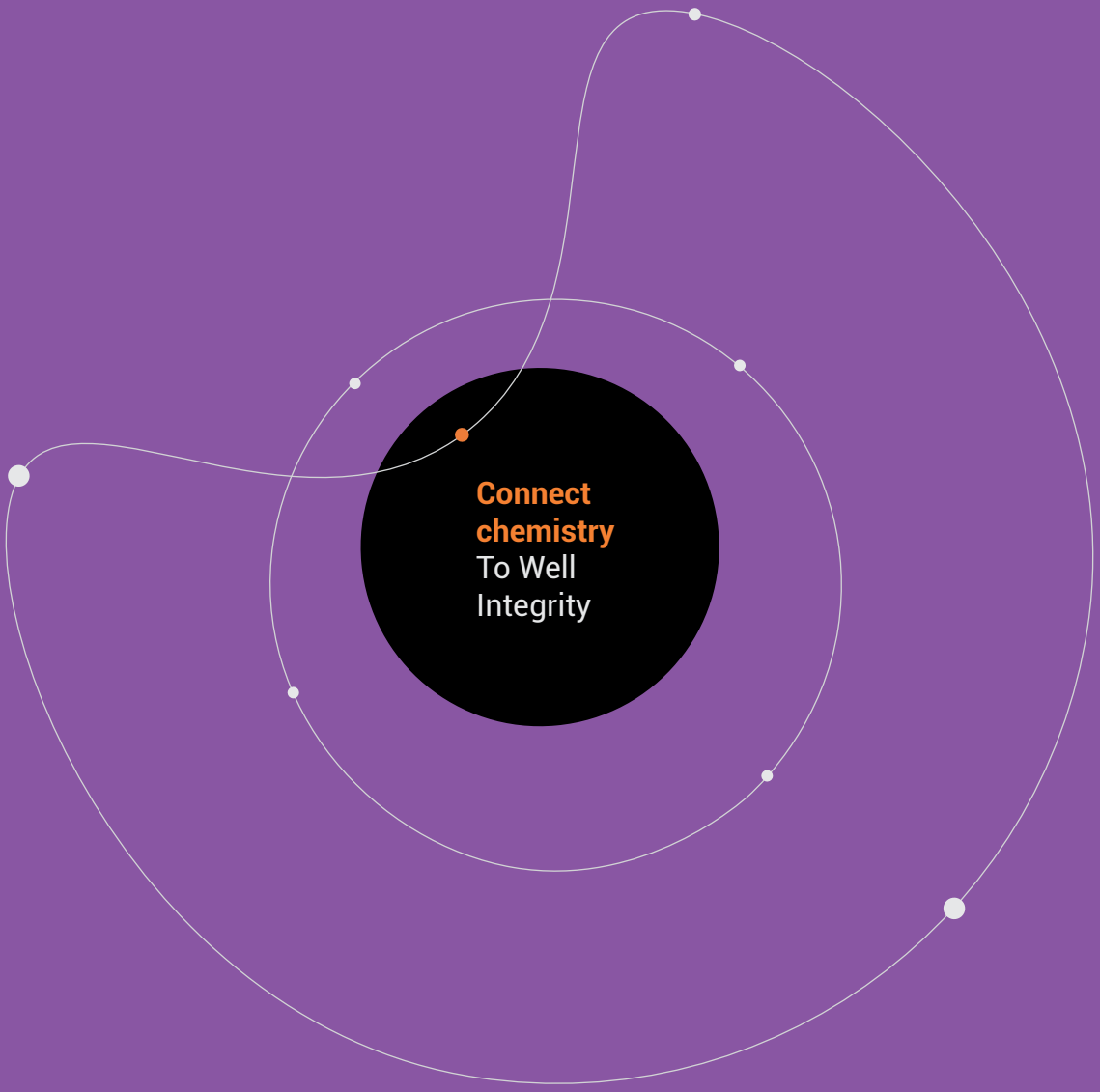
For high-temperature reservoir applications, thermal aging tests need to be carried out. This is to make sure that the Antiscalants are stable at the respective temperatures for the expected squeeze lifetime.

QCM Technique

Quartz Crystal Microbalance (QCM) is a very sensitive mass deposition sensor based on the piezoelectric properties of the quartz crystal. It is used for monitoring the scaling process from Nucleation to the growth phase and provides an understanding of scaling potential and inhibitor efficiency. This technique uses the changes in resonant frequency of the crystal to measure the mass on the surface because the resonant frequency is highly dependent on any changes of the crystal mass.

Compatibility Tests

Mixing of Antiscalants and brine can cause issues when they react with each other. The reaction can cause a change in the physical and chemical structure of the scale solution. Compatibility tests are needed to check that the solution does not precipitate when mixed with formation brines to cause formation damage.



Dutch Oilfield Supply and Services-DOSAS
Hofplein 20, Rotterdam 3032 AC, The Netherlands
Phone: +31(0) 103 40 1900

For further information:
info@dosas.nl
Website: www.dosas.nl

QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001