

PHOSPHOMAN® PHOSPHONATES for Oil and Gas Applications



MAXWELL ADDITIVES PVT. LTD.

An ISO 9001:2015, ISO 14001:2015, ISO 15883,
BS OHSAS 18001:2007 & ISO 22000:2005 Certified Company

PHOSPHOMAN® for Oil and Gas

1 INTRODUCTION: SCALE INHIBITION IN OILFIELD APPLICATIONS.

Since more than 50 years, injection of water into an oil field has been developed as the leading method for secondary oil recovery, i.e. to maintain pressure in the reservoir and to flood the oil from the subsurface strata into the production wells. This technique was originally used in the North Sea wells and is now extended to more and more oil fields in the world. Scale formation is one of the most important problems encountered in secondary oil recovery

What factors are responsible for scaling?

The most important sources of scaling in secondary oil recovery are :

- The mixing of incompatible waters between injected and formation waters. Severe scaling can develop after breakthrough of the injection water (sea water) into the formation water. This phenomenon is very well observed after longer mixing residence time in the reservoir. These typical scales observed vary from field to field, for example in the North Sea, the Barium sulphate scales are hard to remove.
- The change of thermodynamic conditions from the bottom to the top of the well (e.g. drop in pressure and temperature).

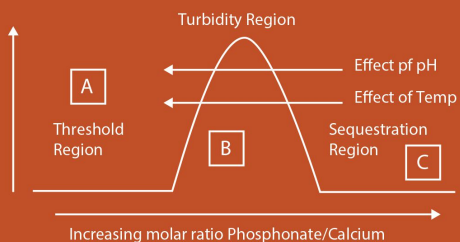
Scaling tendencies are depending on various parameters such as :

- proportion and type of water injected
- dissolved salts in the waters
- temperature applied at various places in the oilfield
- pressure variations existing into the pipes and holes of the oilfield.

Need for scale inhibitors in oilfield recovery.

When scale occurs various possibilities exist to solve the problem :

In some cases, scales can be solubilised by acids or by sophisticated chemical treatment in other cases, when the scaling tendency becomes permanent and serious, preventive scale inhibition is the preferred solution. This involves application of substoichiometric (or "threshold") concentrations of certain polyelectrolytes – e.g. SHMP, polymeric carboxylic acids, organic phosphate esters and phosphonates. The combination of the substoichiometric dosage with large volumes of water involved in oil production makes this method of treatment more economical.



THE THRESHOLD EFFECT OF PHOSPHONATES:

This figure shows the functionality possibilities of a phosphonate : it can be used in the threshold region (A) or in the sequestration region (C). The turbidity region (B) is where one gets precipitation of the phosphonates in the presence of Calcium. By knowing this, it is then important to understand which kind of scale occurs so that we can use the right chemicals to solve the scale problem.

2 Applications of Scale Inhibitors In Secondary Oil Recovery.

One can say that a scale problem either exists and has to be removed or is not yet present and a preventive type of solution has to be installed.

Traditional scale prevention by water injection is done either by:

- Continuous injection
- Squeeze treatment

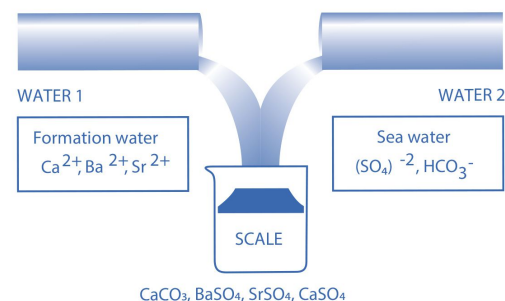
In case of scale removal the ways to solve this problem are either by:

- Acidizing
- Using a scale dissolver
- Fracturing

Additionally, the place where the scale occurs in the oilfield also has an influence on the type of scale. When a scale occurs on the topside, the working conditions will be less stringent. In a downhole scale problem, the conditions are much more difficult because of extreme pressures, temperatures and high salt contents in the waters.

PHOSPHOMAN® products can be used in these types of scale problems and the physico-chemical constraints, as well as environmental constraints, will determine the choice of the PHOSPHOMAN® to use.

The following scheme illustrates the types of scales



The following tables give you the basic physico-chemical data of the various products belonging to our oil field product range

PRODUCT	PHOSPHOMAN® PRODUCT			
	222C	222B	111C	111B
Chemical name	Amino tris (methylenephosphonic acid)		1-Hydroxyethylidene (1,1-diphosphonic acid)	
Molecular weight	299	409	206	294
Appearance	Clear water white to pale yellow aqueous solution			
Active content (as acid)	50%	29%	60%	21%
Chloride (Cl)	< 1%	< 1%	< 0.1%	< 0.1%
Iron (Fe)	< 20ppm	< 20ppm	< 20ppm	< 20ppm
pH (1% at 25°C)	< 2	10-11	< 2	10-12
Specific gravity @ 20/20°C	1.33	1.42	1.45	1.31
Freezing point (°C)	-15	-21	-25	< 5

PRODUCT	PHOSPHOMAN® PRODUCT			
	235G	235GE	2086	333C
Chemical name	Diethylenetriamine penta (methylene phosphonic acid)		Proprietary polyamino- phosphonate	2Phosphono 1,2,4-butane tricarboxylic acid
Molecular weight	573	617	739	270
Appearance	clear, brown aqueous solution	clear, dark amber aqueous solution	clear amber solution	clear, water white to pale yellow aqueous solution
Active content (as acid)	50%	47%	30%	50%
Chloride (Cl)	< 5%	< 5%	< 5%	< 5%
Iron (Fe)	< 20ppm	< 20ppm	< 35ppm	< 20ppm
pH (1% at 25°C)	< 2	2-3	5.5-6.0	1.8-1.9
Specific gravity @ 20/20°C	1.42	1.38 - 1.43	1.33	1.28
Freezing point (°C)	-25	-20	-15	-15

PRODUCT	POLYMAN® PRODUCT		
	POLYMAN® 2000	POLYMAN® 1000 N	POLYMAN® 1400 PN
Chemical name	Homopolymer of maleic acid	Modifield Poly-acrylic acid polymer	Sulphonated Polyacrylic acid copolymer
Molecular weight	900	3500	5800
Appearance	brown liquid	Clear, pale yellow liquid	
Active content (as acid)	47-53%	43-45%	42-44%
Chloride (Cl)			
pH (1% at 25°C)	2.0 max	6.5 - 8.5	3.5 - 4.5
Density at 20°C (g/cm³)	1.20	1.3(25°C)	1.2(25°C)



3 THE PHOSPHOMAN® PRODUCT RANGE FOR OILFIELD APPLICATIONS.

Our Introductory brochure gives you an overview of the whole range of PHOSPHOMAN® as products available as well as the various industrial application range in which they are currently used.

In order to make a primary selection of a PHOSPHOMAN® product that can solve the scale problem, the following table has been developed :

It provides an overview of the performance of PHOSPHOMAN® grades for the inhibition of specific type of scales and some typical applications in which they are currently used



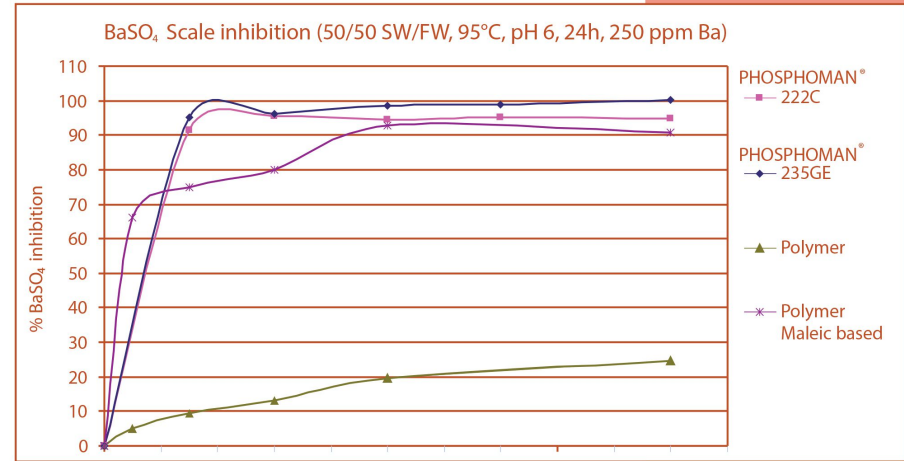
4 Performance characteristics of PHOSPHOMAN® products

Static bottle test.

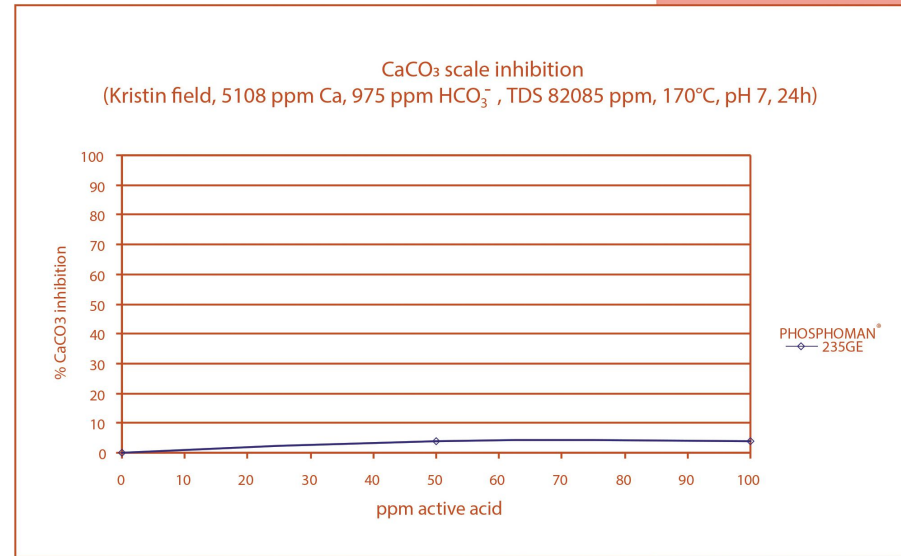
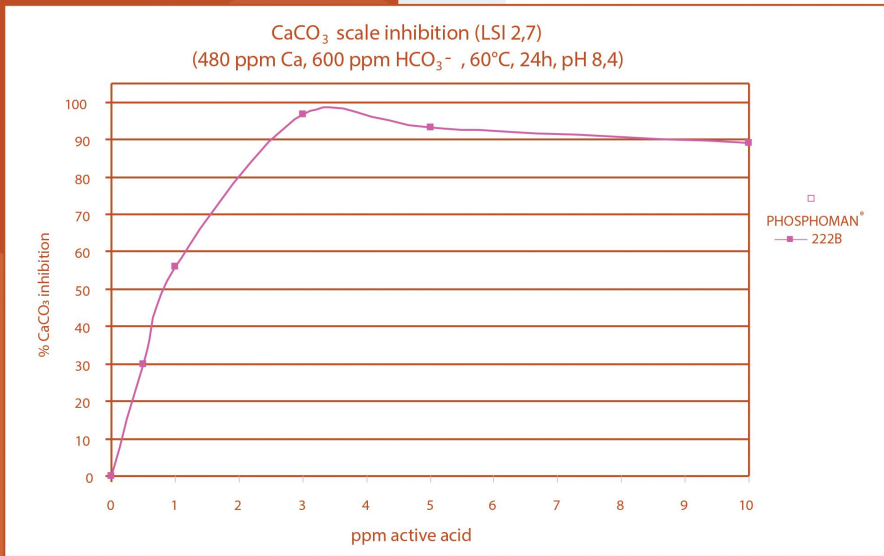
This test is e.g. used to measure the BaSO₄ scale inhibition performance under specific water conditions for secondary oilfield recovery.

PHOSPHOMAN® & POLYMAN® PRODUCTS						
PROPERTY	222C 222B	111C 111B	235G 235GE	2086	333C	POLYMAN® 1000 N 1400 PN
CaCO ₃ Inhibition	++++	++++	++	++	++++	+++
CaSO ₄ Inhibition	++	+	++	+++	+	++
BaSO ₄ Inhibition	++	+	+++	++++	+	++
Corrosion Inhibition	+++	+++	++	++	+	+
High T° Stability	++	++	+++	++	++	++++
High [Ca] tolerance	+++	++	+++	+++	++++	+++
Iron tolerance	++	+++	+	++	++	++
Chlorine Stability	-	++	-	-	+++	++
Some typical applications	Topside low Ca	General Ca	Top scale Squeeze	Ba scale Squeeze	Topside	Down hole

++++ : excellent
 +++ : very good
 ++ : good
 + : satisfactory
 - : not preferred



In the following graphs, the CaCO₃ inhibition was evaluated at different t° conditions in different waters.



Dynamic tube blocking test.

We can use this test to measure CaCO_3 and BaSO_4 scale inhibition performance under high pressure and high T° . like those one find in the brines or in the formation rock.

Following graph shows for a PHOSPHOMAN® the profile in a dynamic tube blocking test. The MIC (minimum inhibition concentration) determination for a specific oilfield can then be calculated from this type of profile and applied for scale prevention or squeeze

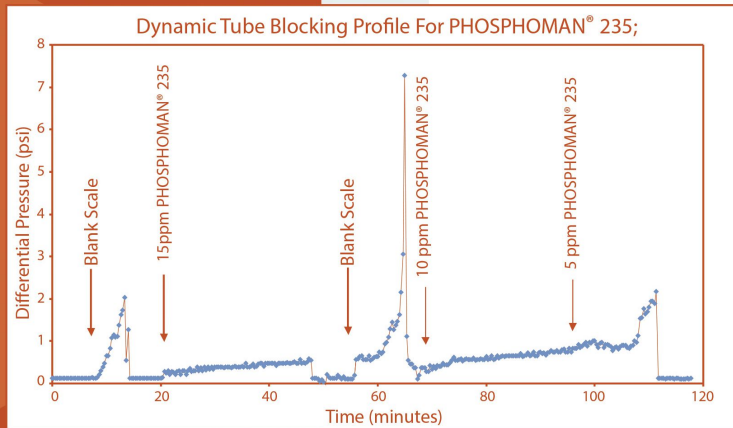


With our technical team we can help you find solutions to your requirements.

5 Packaging

MAXWELL ADDITIVE PVT. LTD. products for oil field applications are available in a whole range of packaging types including 200L drums and 1000L IBC's

Dynamic Tube Blocking Profile For PHOSPHOMAN® 2066;





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