Methodology

01

ANALYSIS

An information survey is carried out to create a record of the conditions of the well and of the entire production system. At this stage we locate the problem area to be treated.

02

DIAGNOSIS

Samples are taken from both the formation water and the minerals that begin to be deposited in the system; this is sent to the laboratory to determine the nature of the liquid and the chemical and physical composition of the scale.

03

TREATMENT SELECTION

According to the profile of the deposits and their location within the system, the most appropriate injection technique is chosen to solve the problem.

04

EXECUTION

During this stage, the Apollo team of specialists implements the work plan, according to the chosen technique.

05

MONITORING AND CONTROL

At the end of the treatment, a meticulous record of the inhibitor residual, the pressure and temperature at the wellhead and the conduction lines, as well as the chemical product consumption, is carried out. In addition, the injection system is periodically inspected and maintained to, if necessary, adjust the treatment and optimize the customer's production levels.

Apollo

Complete solutions to prevent scale build-up in wells, before mineral deposits choke your production system.

Well Scale **Inhibitors**

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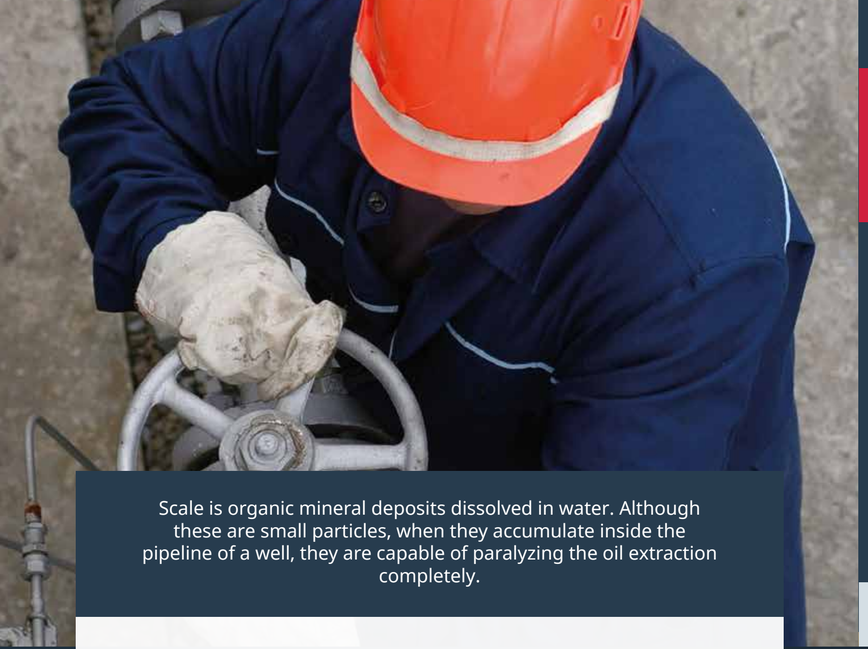
Complete solutions that are applied throughout its value chain



Scale is organic mineral deposits dissolved in water. Although these are small particles, when they accumulate inside the pipeline of a well, they are capable of paralyzing the oil extraction completely.

Cases of scaling have been documented where production dropped from 30,000 to zero barrels per day, over the course of no more than 24 hours.

The programs that exist for the removal of scale in producing wells are services that are as efficient as they are expensive. It is estimated that they can cost up to a quarter of a million dollars, an amount to which the economic losses that accumulate due to the drop in production must still be added.

Thanks to the expertise granted by 30 years serving the Mexican energy industry, Apollo has managed to develop a portfolio of comprehensive solutions **to inhibit the development of scale in wells.** These services prevent the formation of mineral deposits and scale **without damaging the extraction infrastructure.** In this way, the customer saves on preventive removals long before scale build-up stalls production.

What can Apollo do for your process?

The best scale imbibition program is the one chosen taking into account the type, quantity, physical composition, texture and location of the precipitated minerals; these can be focused on different parts of the production system.

The most common types of scale are:

- Calcium carbonates
- Calcium, barium and strontium sulfates
- Iron compounds

And they can be located in the:

- Face of the formation
- Production pipeline
- Chokes
- Downpipes
- Conduction lines
- Surface equipment

The following table shows **the chemical agents Apollo uses** for this treatment and the application details for each:

		INHIBITION TO CALCIUM CARBONATE	BARIUM SULPHATE INHIBITION	INHIBITION TO OTHER COMPOUNDS	APPLICATION TECHNIQUE	THERMAL STABILITY
POLYMERS	PHOSPHONATES	Excellent	Good	Calcium, strontium and iron sulfate	Surface and Downhole	Up to 180 ° C
	PHOSPHATE ESTERS	E	B	Calcium sulfate	S	Up to 180 ° C
	POLYCARBOXYLATE	E	B	Calcium sulfate	AFP	Up to 260 ° C
	POLITARTARIC ACID	E	Very good	Calcium phosphate	AFP	Up to 260 ° C
	SULPHONE COPOLYMER	E	B	Calcium sulfate	S, AFP	Up to 260 ° C
	SULPHONATED MULTIPOLYMER	E	MB	Calcium sulfate	S, AFP	Up to 260 ° C

Depending on the need of each case, **various techniques are offered to inject the chosen chemical agent,** either superficially or downhole:

SURFACE INJECTION TECHNIQUES

- **Sounding valve:** This method offers excellent results for problems that are located in valves, chokes and downspouts, since the turbulence that is concentrated in these areas helps to better incorporate the product.
- **Downpipe:** For deposits located in the runoff line. The downpipe of the well is used to inject the product.

DOWNHOLE INJECTION TECHNIQUES

- **Capillary tubing:** Technique whose use is recommended when scale is found in the production tubing. The product is delivered to the target area with the help of a steel tube with a reduced diameter (from one to three quarters of an inch).
- **Forced injection (*squeeze*)**: Useful when the scale is in the formation. By injection, the products are forced to reach this area, which is where the most significant pressure and temperature variations occur.
- **Fracture fluids**: Applicable when there is a suspicion that there are deposits both in the formation and on its front part. In the pre-wash and placement stage, during the fracturing treatment, the inhibitor is pumped into the entire fracture, which is filled with holding agent. Before this type of technique is recommended, the compatibility between the inhibitor and the fracturing fluids must be checked.
- **Pneumatic pumping line**: For scale deposits found in the pipeline. The chemical is sent downhole through the artificial lift gas line, allowing it to be incorporated into the fluid being produced.