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Chemical Intervention Technology For Low-Risk Annular Isolation In Existing Gravel Packed Wells And Uncemented Annuli

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Abstract

It is often desirable to be able to intervene to isolate specific areas within a wellbore. Throughout the life of a well, undesirable changes to production such as increased water may occur that cannot be easily dealt with using mechanical means, unless the completion has been designed with this in mind. Examples include flow through uncemented annuli, or from part of a gravel packed completion. In such cases, a possible solution may be to pump a treating fluid with properties that will provide the isolation required. Several different systems are available such as crosslinked polymer fluids, portland cement, or other hard setting materials.

This paper reviews the properties of one such product, a magnesia cement system, evolved from chemistry that had previously been employed in other applications. The new technology uses fine-grained materials that can be squeezed though small restrictions such as narrow annuli, slots or perforations, or through well screens and into the gravel pack beyond, where later they will set hard and provide selective isolation of the treated section to prevent the flow of unwanted fluids. As with the original chemistry, the new system is composed of acid soluble components, allowing the solid set material to be removed in the future should it be required.

This paper will identify the requirements associated with selecting hard setting materials use in for zonal isolation. It will discuss the development of this squeezable magnesia cement system, showing how it meets these requirements. The results of extensive laboratory evaluations will be reviewed and recent case histories will be discussed.

This technology is expected to find wide application in many existing gravel-packed and un-cemented wells worldwide, when low risk long-term zonal isolation becomes required.

Introduction

Many problems may present themselves when unwanted water or gas approaches a producing wellbore. The most apparent may be a reduction in the well productivity, which can be caused by the onset of multi-phase flow and relative permeability effects, by the creation of water blocks, by an increase in produced water cut and corresponding increased hydrostatic head, or by an unfavourable water flooding sweep efficiency due to high permeability streaks. Additionally, an increase in water production can also lead to higher corrosion of wellbore tubulars and surface equipment, and additional productivity losses from inorganic scaling and fines migration. On surface, the water-handling facilities have to be built to cope with the large volumes involved, and of course, the produced water has to be disposed of by an acceptable means. All of these issues have an associated cost, which ultimately must be offset against the value of the produced hydrocarbon, effectively lowering the net value of the produced oil or gas. These costs do not appear to be well recognised, although they can be substantial, particularly in mature areas where the water cut is high.

While there are several well-proven chemical treatment solutions available for reducing water or gas flow within the reservoir, for the most part, it is essential that these treatments are applied directly to the water/gas zone which is presenting the problem. If erroneously squeezed into the wrong zone, a shut-off treatment will stop hydrocarbon flow as efficiently as it stops water/gas flow. Often it is not possible to squeeze the water zone in question because the type of completion will not allow that zone to be isolated. These cases include wells completed with slotted liners, sand control screens, gravel packed intervals and multi-lateral sections. This is also the case when the water flow is occurring in an uncemented annular space or between casing strings. Mechanical zonal isolation is not possible in these completion types because a flow path exists beyond the inner casing or screen. This paper discusses the development of a removable zonal-isolation product which can be used to overcome the above limitation.