Recommended Practice on Determination of Shrinkage and Expansion of Well Cement Formulations at Atmospheric Pressure

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API Foreword

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Standards referenced herein may be replaced by other international or national standards that can be shown to meet or exceed the requirements of the referenced standard.

This American National Standard is under the jurisdiction of the API Subcommittee on Well Cements Sc10. This standard is considered identical to the English version of ISO 10426-5:2004. ISO 10426-5 was prepared by Technical Committee ISO/TC 67, SC 3 drilling completion and well cements.

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Foreword

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ISO 10426-5 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 3, *Drilling and completion fluids, and well cements*.

ISO 10426 consists of the following parts, under the general title *Petroleum and natural gas industries — Cements and materials for well cementing*:

— *Part 1: Specification*

— *Part 2: Testing of well cements*

— *Part 3: Testing of deepwater well cement formulations*

— *Part 4: Preparation and testing of foamed cement slurries at atmospheric pressure*

— *Part 5: Determination of shrinkage and expansion of well cement formulations at atmospheric pressure*

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Introduction

Dimensional changes in oil- and gas-well cements after placement, phenomena often referred to as shrinkage, (when the dimensional change corresponds to a decrease in cement volume) have often been used to explain various wellbore phenomena including

— a microannulus, leading to a bad bond as demonstrated by the bond log;

— interzonal communication, resulting in costly remedial operations;

— lack of a hydraulic seal when utilizing cement inflatable packers.

Attempts have been made to find additives that decrease cement shrinkage (shrinkage being a fundamental characteristic of Portland cement) The best solution for shrinkage thus far has been the identification of additives that favour the expansion of the cement. However, even if cement expands dimensionally, it will still shrink internally. In this case, the bulk expansion of the cement sample is simply superimposed on an inner shrinkage that will affect the porosity of the sample.

Shrinkage and expansion in cement result from the formation of hydration products having a density different from the compounded density of the reaction components. This can result in the following:

— change in pore volume;

— change in pore pressure;

— change in sample dimensions;

— change in internal stress.

In a closed cell with a non-deformable boundary, the volume of hydrates produced during the chemical reaction is less than the volume of dry compounds plus water. The change in volume of hydrates will be referred to as inner hydration shrinkage. The change in the sample dimensions will be referred to as bulk shrinkage or expansion. Bulk shrinkage and expansion of cement refer to the result of the measurement of linear dimensional change or volume change. The volume to which all volume changes are related is the volume of the slurry immediately after mixing and emplacement in the experimental equipment.

In this part of ISO 10426, units are given as SI, and where practical, U.S. Customary units are included in brackets for information.

Users of this part of ISO 10426 should be aware that further or differing requirements might be needed for individual applications. This part of ISO 10426 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

This part of ISO 10426 is based on API Technical Report 10TR 2 [1].

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