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## Design Methodology for Swellable Elastomer Packers in Fracturing Operations

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### Abstract

During the past 7 years, swellable elastomer technology has been so well accepted in the oilfield that its scope of application has shown an unusually rapid expansion. Its success has been due to its capability to form a permanent seal through its elastomeric expansion in hydrocarbon or water. With the increasing acceptance of this concept for the oilfield, new field applications are being explored; this paper will discuss the application of swellable elastomer packers (SEPs) in stimulation operations. These applications include acid stimulations and/or hydraulic fracturing operations.

This paper will explore the technical challenges, and the resulting design concepts were developed. The design process included modeling of downhole parameters and anchoring forces as well as laboratory testing that included thermal contraction measurements that were developed to resolve the technical challenges for stimulation operations. The resulting design methodology is not limited to stimulation applications but is applicable to any scenario with dynamic loads on SEP applications such as in water injection wells, etc.

Finally, case histories are provided to illustrate the successes that have been achieved using the SEP methodology developed for stimulation scenarios.

### Introduction

It has been approximately 7 years since swellable technology was introduced to the oilfield, and since its introduction, many changes in the technology have taken place.

Initially, the main application was for use as a swellable element for packers. (Kleverlaan et al, 2005; Morrison et al, 2005; Murphy et al, 2005; Freyer, 2005; Hembling et al, 2006; Triolo et al, 2006; Antonio et al, 2007) (These swellable elastomer packers were designed to provide zonal isolation in an openhole environment. As the technology became more and more accepted, and operators gained confidence in the capabilities of the technology itself and in running SEPs in wells, other applications were explored, and the swellable elastomers have now been used to perform in a variety of applications.

The latest success has occurred in the area of stimulation operations, in which SEPs have been subjected to a very specific set of conditions that significantly affect the sealing performance of the tool(s).

Three primary challenges must be addressed when designing SEPs for stimulation applications:

1. The downhole conditions; i.e., the main parameters such as the downhole pressure and the average temperature of the sealing elements, to which the tool will be subjected.
2. Anchoring forces; i.e., the forces from the shrinkage of the pipe during the treatment that occur, that in turn, subject the SEPs to additional forces that do not occur in conventional zonal-isolation applications.
3. Thermal contraction of the sealing element; i.e., the contraction that occurs due to the injection of the stimulation fluids that will cause the temperature of the packer to drop. This phenomenon causes the sealing element to partially contract and will result in altered sealing properties. Ultimately, the loss of the pressure seal can occur.

The initial applications have allowed operators to design wells in openhole completions that simplify operations (since cementing and perforating were no longer needed) and these simpler completions have resulted in higher production.

### Successes Recently Experienced in Other Operations

Several other applications have emerged since the introduction of expandable technology, and these have included the following:

- Compartmentalization of the completion to prevent fines migration into the annulus