An overview of polymer-based conformance treatment from past to present

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Conformance treatment becomes significant not only because of the matured oil fields but also as a means to improve the oil recovery. In relation to this, polymer-based systems show their applicability to the conformance treatments with many various materials and methods. However, there are many issues limiting the performance of the present technique. Herein, this poster introduces conventional methods, commercial products, and recent developments, including their principles and the limitations.

**Abstract**

The polymer system for conformance treatments must be carefully chosen upon many different considerations such as temperature, pH, and permeability of the reservoir. Furthermore, the identification of the conformance problem is also important.

The polymer systems for the conformance treatment are divided into two categories [1]. Polyacrylamide (PAM) is one of the conventional materials for a synthetic polymer, while xanthan and hydroxyethyl cellulose are widely used as bio-polymer.

**Introduction**

There exist many different methods based on the polymers shown above. In general, they are categorized according to where the gelation occurs; in-situ gel and preformed gel. These two gel systems can be sub-categorized by whether it forms 3-D network or particles (in the case of in-situ gel) and by the size of the particles (in the case of preformed gel) [table 1].

**Methods**

The different methods of EOR and the issues within reservoirs are shown in figure 3 and 4. However, no matter which methods are used, many problems can limit the EOR treatments. In this regard, figure 5 shows the possible problems within reservoirs.

Apart from the adsorption, the early gelation also causes a plugging behavior. On the contrary, the delayed gelation (or no gelation) can result in wash-off. With respect to this, figure 6 shows parameters that can cause loss of gelation control together with some other issues.

**General problems**

The self-healing polymer gel shows sol-gel transition depending on the shear stress. Therefore, the preformed bulk gel can be easily injected and then behave as a gel when it reaches in-depth reservoirs [b, figure 8]. Furthermore, the PPG system made of self-healing polymers can increase its particle size by recombination [c, figure 8][ref. 4].

**Further development**

Further advanced methods are achievable by different polymer systems such as self-healing polymers and stimuli-responsive polymers. The gel made of thermo-responsive polymers can expand its volume by temperature change [a, figure 8][ref. 3]. The self-healing polymer gel shows gel sol transition depending on the shear stress. Therefore, the preformed bulk gel can be easily injected and then behave as a gel when it reaches in-depth reservoirs [b, figure 8]. Furthermore, the PPG system made of self-healing polymers can increase its particle size by recombination [c, figure 8][ref. 4].

**References**


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**Table 1. The variety of methodologies for polymer systems.**

<table>
<thead>
<tr>
<th>Method</th>
<th>Gelation</th>
<th>Crosslinking</th>
<th>Summary</th>
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<tbody>
<tr>
<td>Bulk gel</td>
<td>Intra-molecular</td>
<td>Crosslinking</td>
<td>Precipitation, Accelerated reaction, Biofilm formation</td>
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**Figure 1. Monomers for synthetic polymer system (left) and bio polymers (right) for the conformance treatment.**

**Figure 2. Structures of inter- and intra-molecular crosslinked polymer system and reversible (self-healing) bond.**

**Figure 3. Different methods for EOR by relative permeability modifier (RPM, a), Preformed particles (b), and plugging by bulk gel (c).**

**Figure 4. Possible near-wellbore (1 and 2) and far-wellbore issues (3,4,5, and 6) within reservoirs.**

**Figure 5. Adsorption (a) and syneresis (b) of polymer gel within reservoirs.**

**Figure 6. Parameters that can cause problems within reservoirs.**

**Figure 7. Structure of the repeating units.**

**Figure 8. Volume expansion of the gel (a), sol-gel transition of self-healing bulk polymer gel (b), and recombination of particle gel made of self-healing polymers (c).**