HERIOT WATT UNIVERSITY

FAST Research & Consultancy

Polymer EOR - Part II: Corefloods

Polymer Enhanced Oil Recovery

As discussed in "Polymer EOR – Part I: Rheology", polymer flooding is an enhanced oil recovery (EOR) technique, which aims to increase the oil recovered by 10-35%. Once the rheological properties of the polymer have been determined, and the target viscosity identified via modelling, coreflooding moves to the forefront of the laboratory study.

Coreflooding is a dynamic test that aims to reproduce the reservoir conditions as closely as possible. In Polymer EOR, it is most commonly used to: measure the polymer adsorption; examine the In-Situ rheology of the polymer; and to assess the injectivity of the chosen polymer. The improved sweep efficiency of a polymer flood typically cannot be measured in a coreflood due to the small core size and the fact that the core is relatively homogeneous.

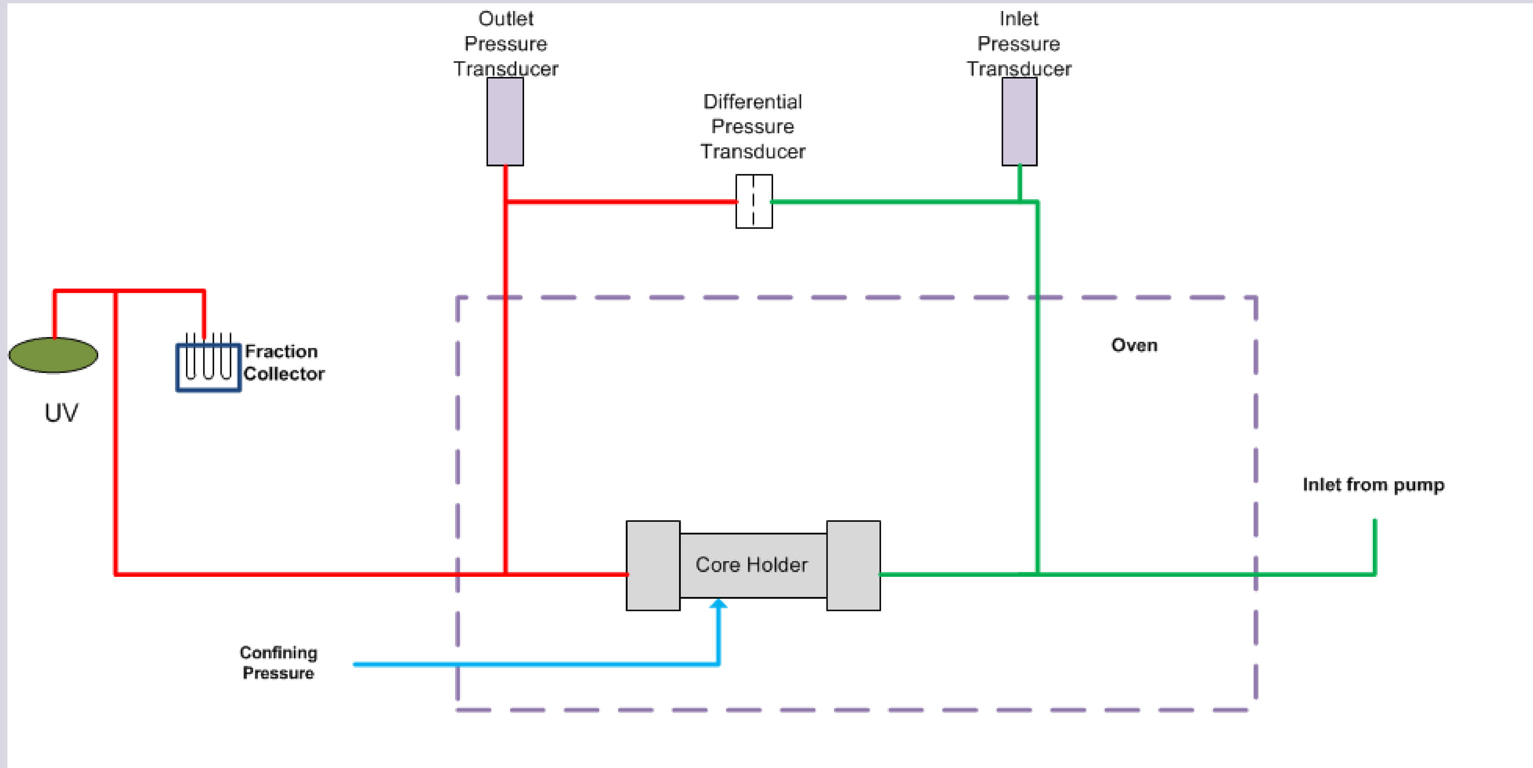

Figure 1. Simplified Coreflood Rig

Polymer Injectivity

Poor injectivity has been highlighted as one of the major risks in polymer flooding (Chapman et al., 2015). The two most identifiable components of polymer injectivity are molecular weight (as discussed in "Polymer EOR – Part I: Rheology") and Solution Quality (SQ).

Solution Quality relates to the efficiency of the hydration/inversion (powder/emulsion) of the raw polymer product. Improper polymer preparation of the polymer can lead to the formation of microgels which will cause pore blocking. High Mw components left over from the manufacturing process can also lead to poor injectivity.

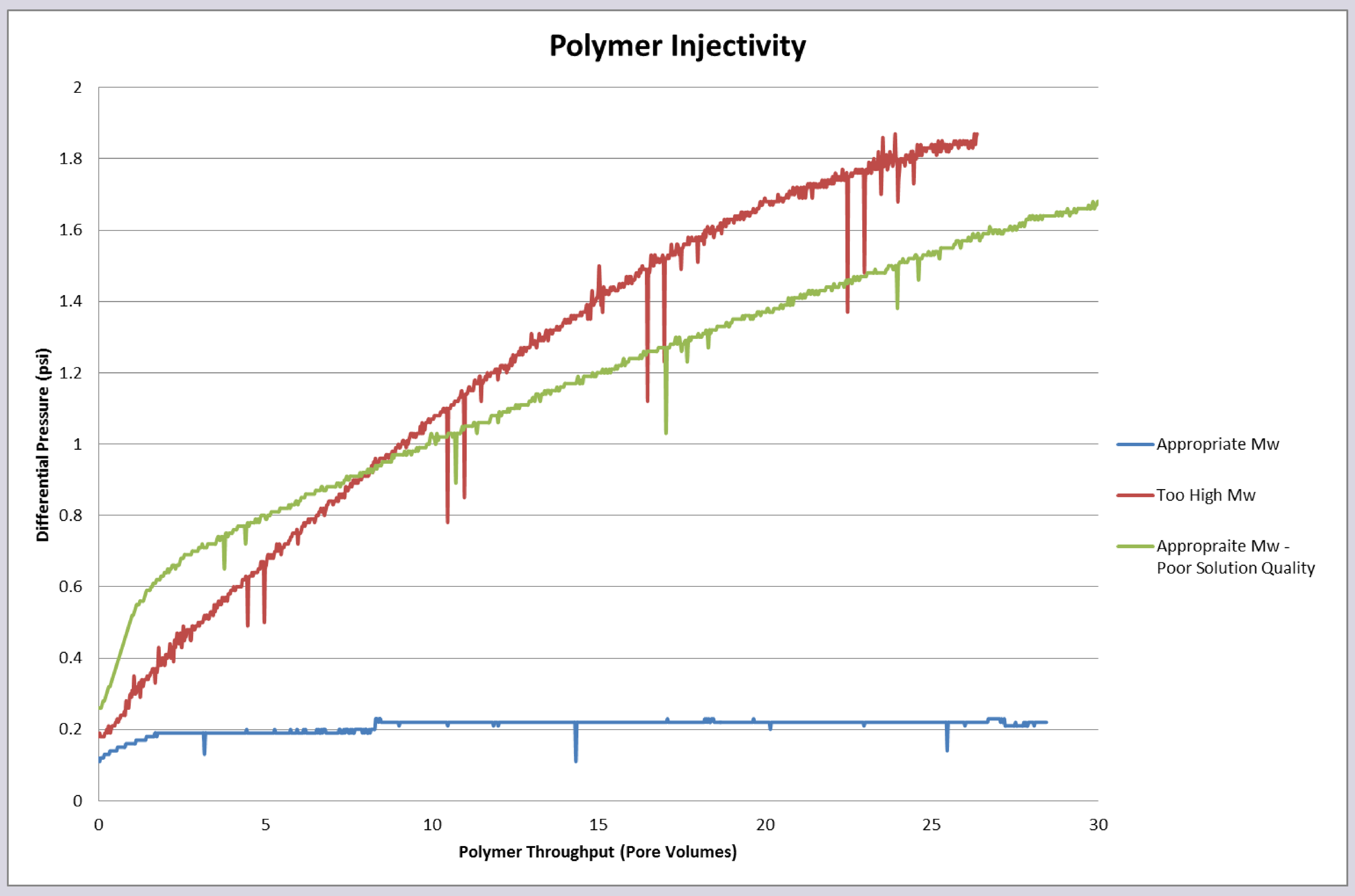

Figure 2. Effect of Mw and SQ on Polymer Injectivity for a Specific Permeability

In-Situ Rheology

Polymer rheology in porous media differs from that of a bulk rheology sample, in that, rather than undergoing shear thinning, it shows properties of shear thickening. When the polymer flows through porous media it undergoes a series of elongations and contractions as it moves between pore bodies and pore throats. At low flow rates the polymer's relaxation time is less than the time spent in the pore body and it can thus re-coil, whereas, at high flow rates the polymer remains elongated and experiences strain. Once the polymer molecule has elongated, viscous friction is introduced and results in an increased viscosity (Sorbie, 1991).

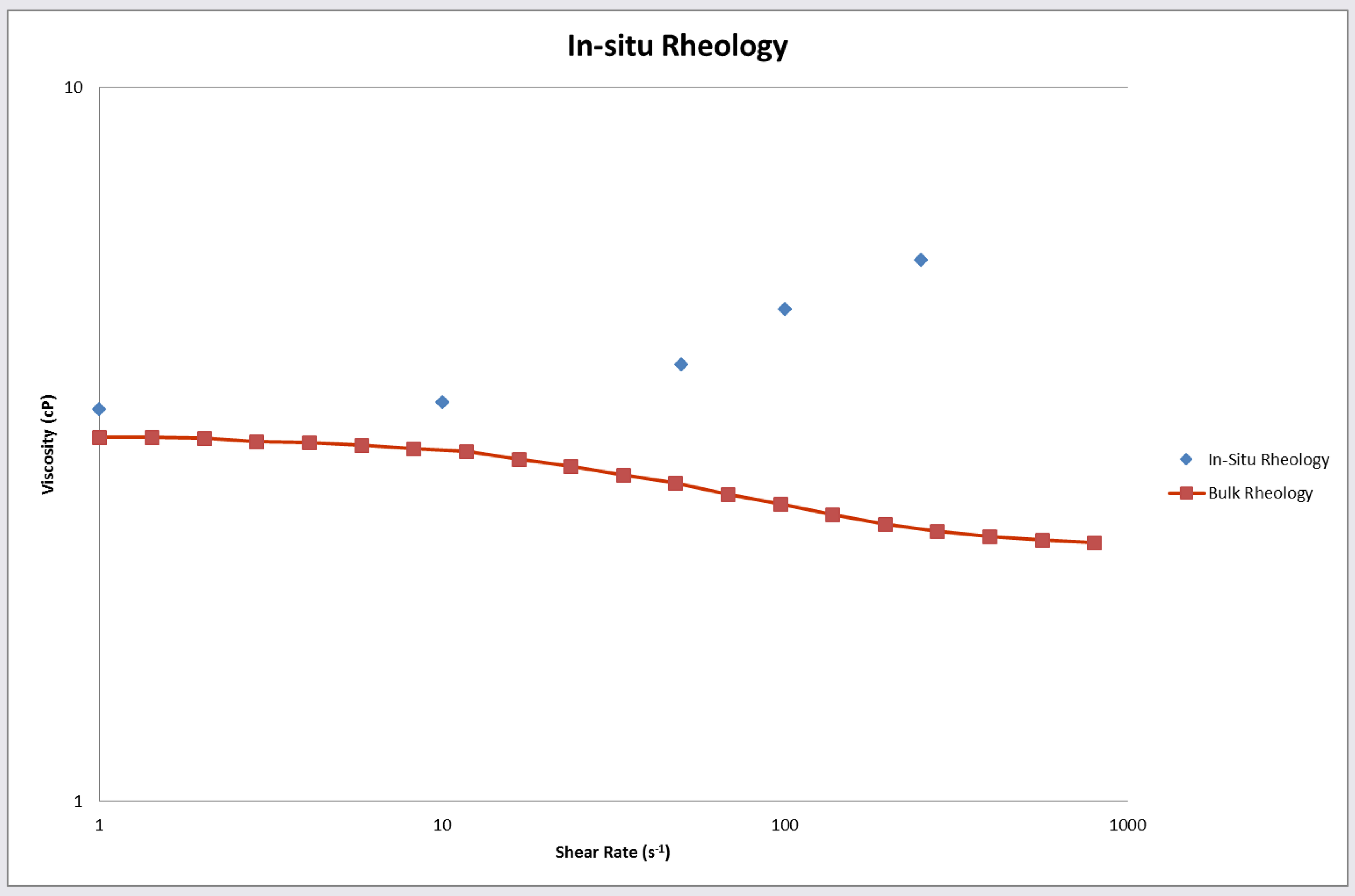

Figure 3. In-Situ Rheology

Dynamic Adsorption

A critical parameter for designing a polymer flood is the polymer adsorption. If it is too high, the polymer will not propagate into the reservoir and the viscosifying power will be lost. A dynamic test allows the use of field core, with a representative surface area, to be used and the adsorbance to be measured in the presence of residual field crude oil.

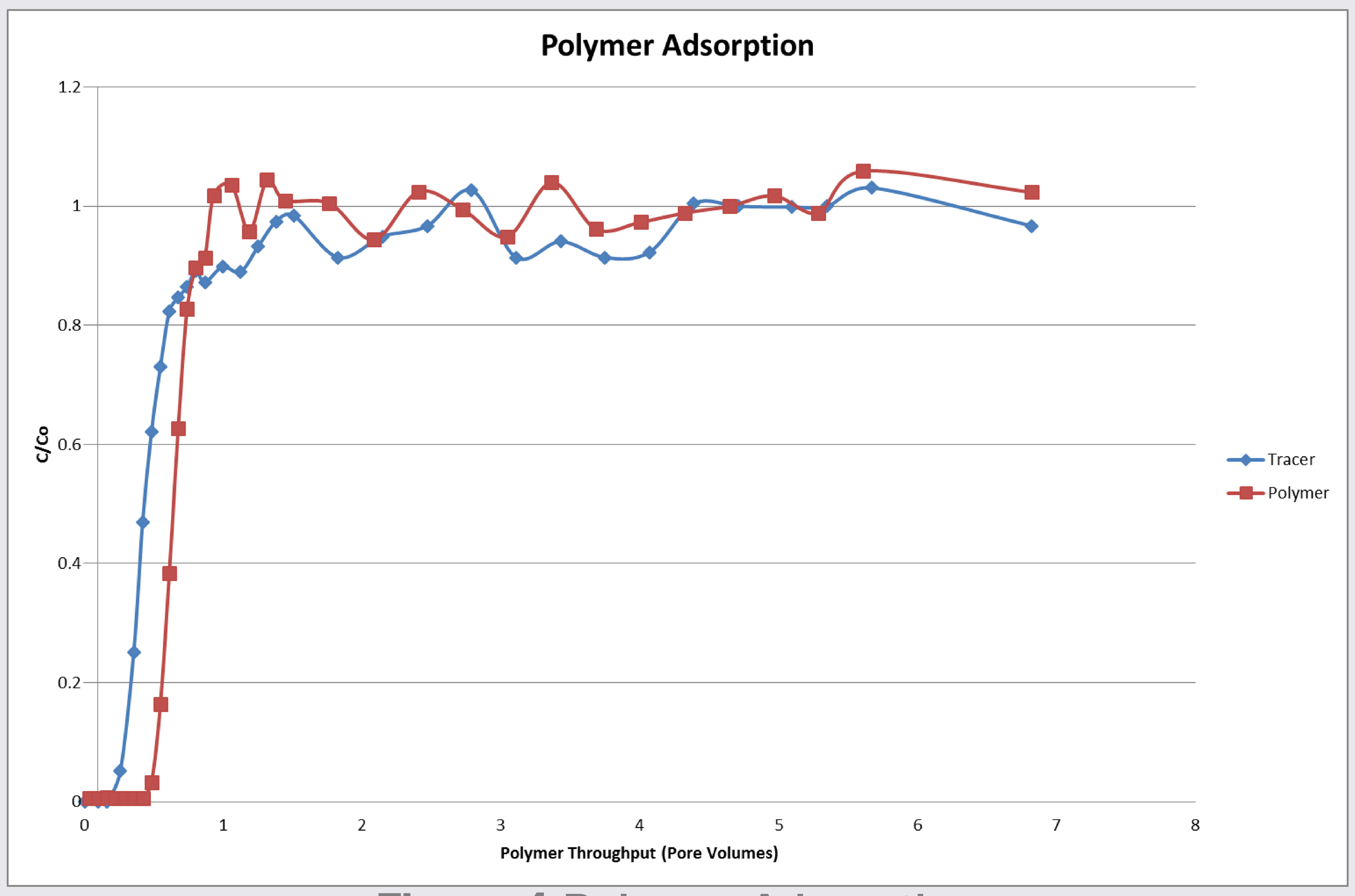

Figure 4 Polymer Adsorption

Contact: Alan Beteta - (A.Beteta@hw.ac.uk)
Robin Shields – PI - (Robin.Shields@hw.ac.uk)

References:

- Chapman, E.J., Mercer, D., Jerauld, G., Shields, R., Sorbie, K., Mogford, D., Cable, A., 2015. Polymer Flooding for EOR in the Schiehallion Field - Porous Flow Rheological Studies of High Molecular Weight Polymers. Presented at EAGE 18th European Symposium on Improved Oil Recovery, Dresden, Germany, 14–16 April 2015
- Sorbie, K.S., 1991. Polymer Improved Oil Recovery. Blackie.