November 1, 2017 - 24th IPEC – Mehrdad Hesampour, Miguel Pelaez and Iris Porat

Treatment of polymer flooding produced water

kemira

Table of content

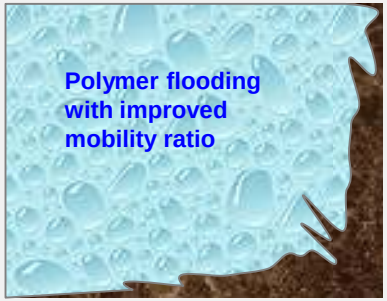
Why do Enhanced Oil Recovery (EOR)?

M	Most oil remains in reservoir (only 15-36 of oil in place are produced)
E	By using EOR methods more oil can be produced.
P	Polymer flooding increase oil production in range of 5-30%

How does polymer EOR Work?

L	Lower viscosity of water > higher flow velocity than oil
I	Increase water viscosity by addition of polymer
I	Improve mobility ratio of water to oil

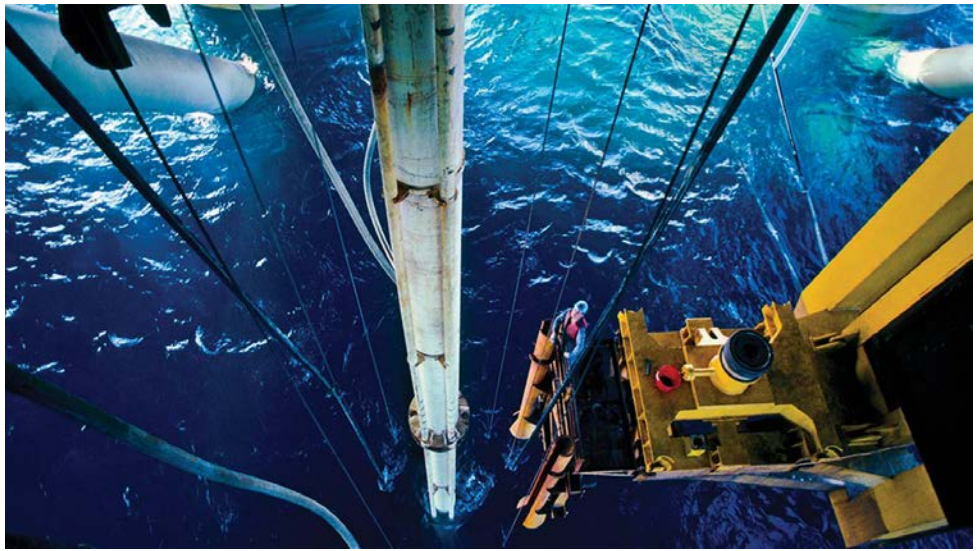
Water flooding with poor mobility Ratio and low sweep efficiency



Polymer flooding with improved mobility ratio and high sweep efficiency

Polymer EOR Produced water challenges

H	Large amount of water contains oil and polymer are produced.
T	Higher viscosity of water affects separation efficiency in primary separators
G	Tighter regulations regarding produced water disposal Growing need for fresh water for beneficial reuse.



Objectives

- Enhance oil removal in polymer EOR produced water treatment by using coagulant
  - Meet discharge or re-injection criteria
- Improve operational efficiency
  - Optimize dosage and operating windows for coagulants
  - Reduce sludge production

Materials and Methods

Product performance evaluation in lab

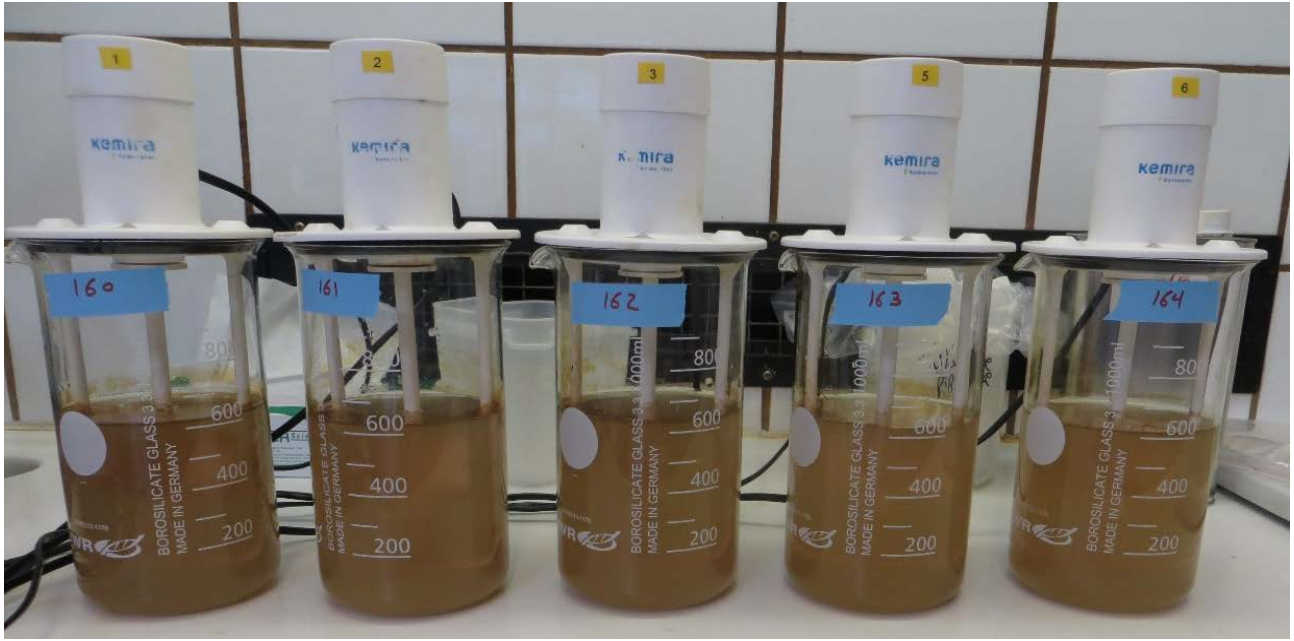
Analysis

- Viscosity, TOC from Ref sample and treated samples
- Floc strength
- Sludge dryness
- Water
  - Synthetic (mole) water contains polymer, oil and salt
- Method
  - Polymer was mechanical sheared to simulate conditions in produced water
  - Test carried out in Kemira ‘s miniflocculator
  - Design of experiment was applied to optimize number of experiments and analysis of results
  - 4 variables (pH, coagulant compositions and dosages),10 chemistries were evaluated in lab.

Materials and methods

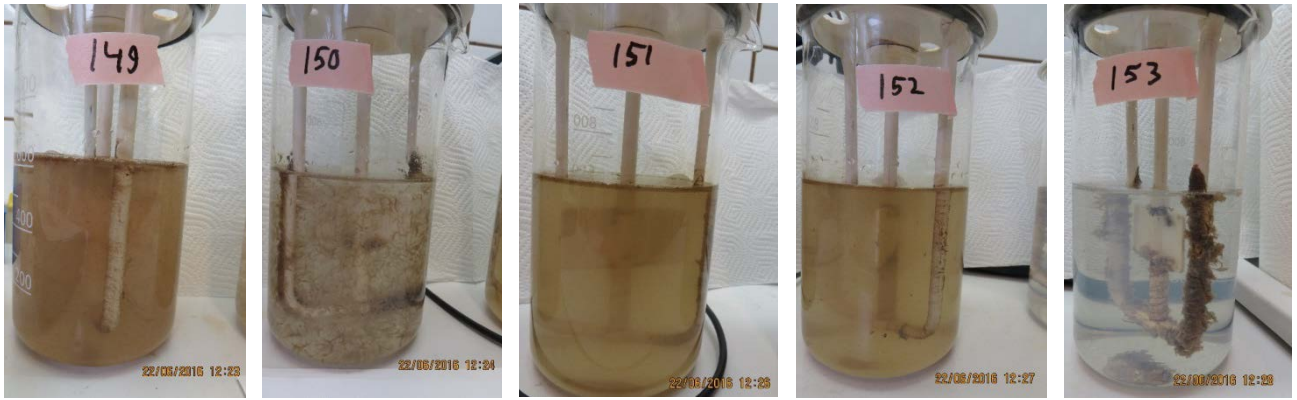
Pictures of feed samples

Polymer (400 ppm) dissolved in brine



Polymer+ oil mixtures before coagulation

Results, model water treatment in lab

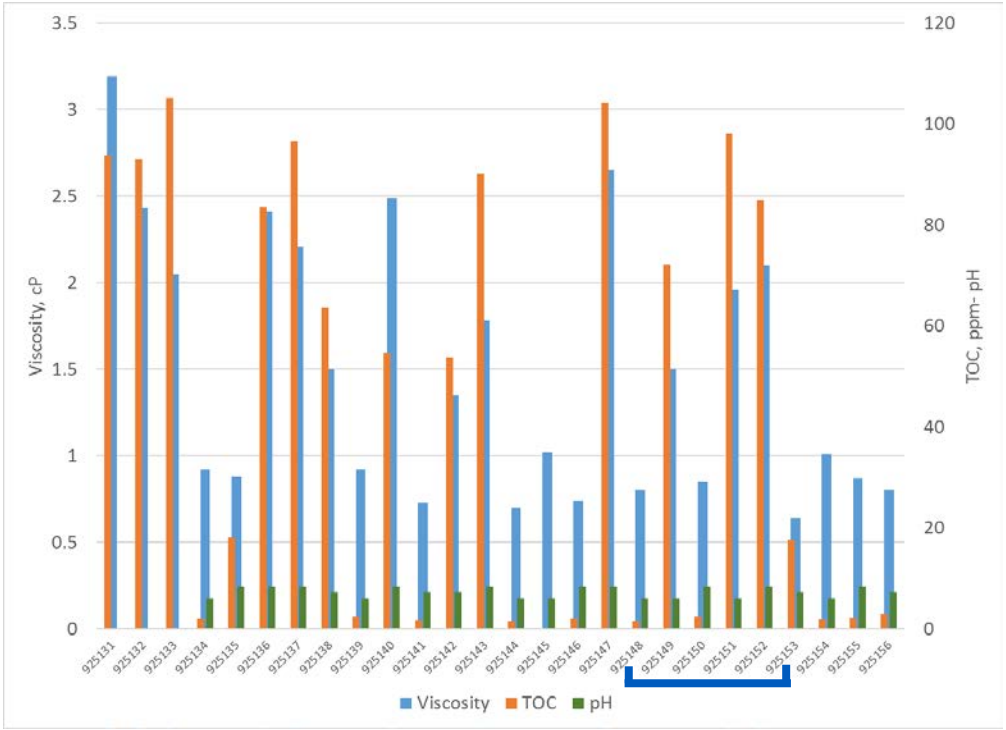


- There is clear difference between size and shapes of flocs.
- The dosage of component 3 has clear influence on size of flocs.

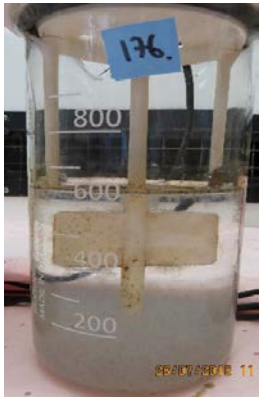
Sample no	Component 1, dosage	Component 2, dosage	Component 3, dosage	pH
149	High	Minimum	Minimum	6
150	High	Minimum	High	8.4
151	High	High	Zero	6
152	High	High	Zero	8.4
153	High	High	Medium	7.2

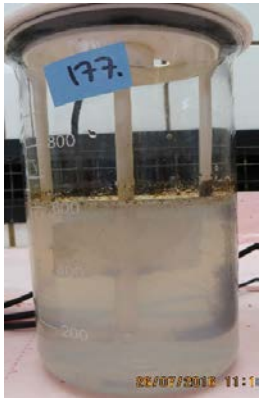
Results

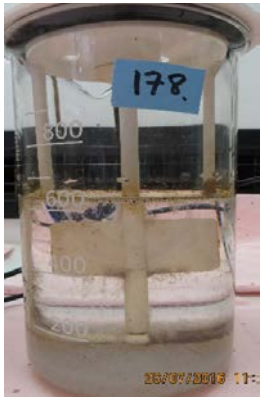
- Viscosity reduced significantly (from 2.6 cP in initial sample to about 1 cP in treated samples)
- TOC removed up to 90% (initial value of 100 ppm to about 1 ppm in treated samples)
- Best results are obtained when dosage of component 3 in composition was at the highest level.

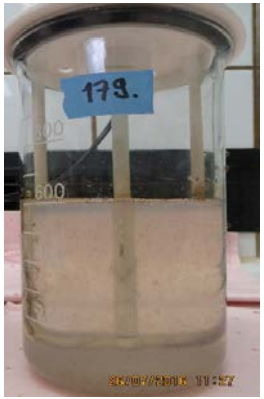


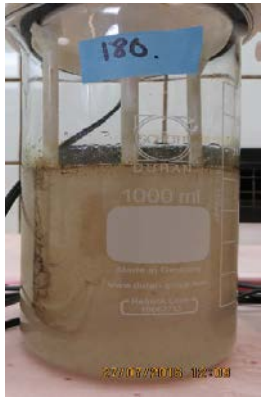
Results, model water treatment in lab









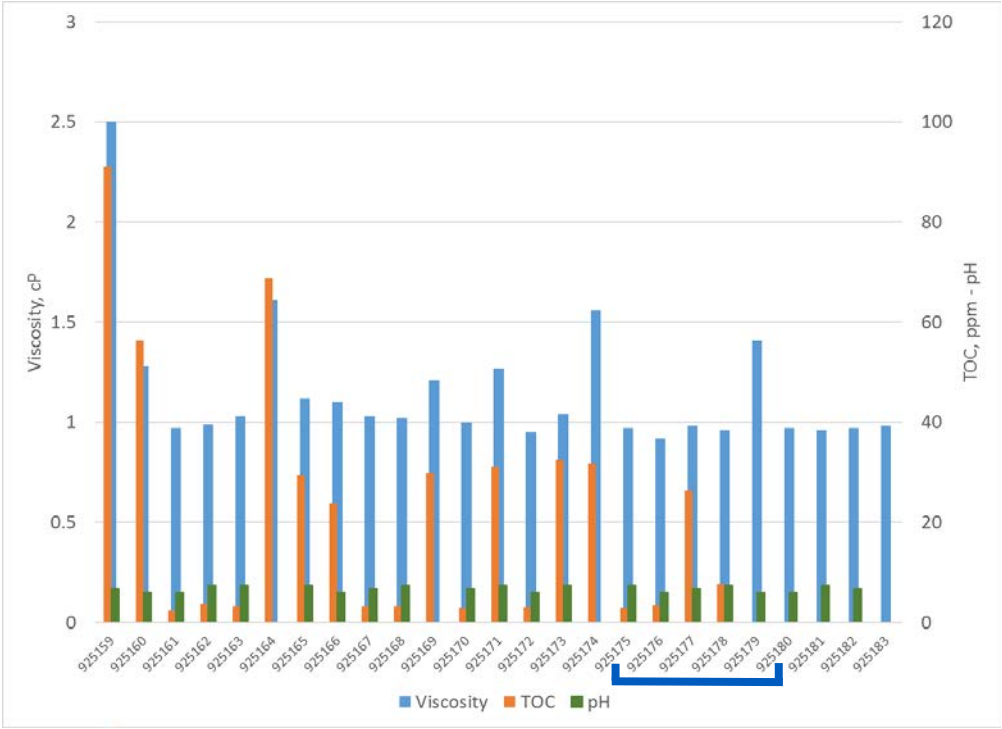


- Sludge volumes are different with earlier experiments
- Floc shape and size are different with previous experiments.

Sample no	Component 1, dosage	Component 2, dosage	Component 3, dosage	pH
176	High	Minimum	Maximum	7.6
177	High	Medium	Minimum	6
178	High	Medium	Medium	6.75
179	High	High	Minimum	7.5
180	High	High	Medium	6

Results

- Similar results with viscosity (reduced clearly from 2.6 cP to about 1 cP)
- Significant TOC removal
- The component 3 has clear influence on viscosity and TOC reduction.
- pH has positive influence on viscosity and TOC reduction.



Take away messages

- The criteria for selecting best performing product was maximum reduction of viscosity, TOC and minimum sludge production
- Selected products removed TOC and decreased viscosity remarkably (up to 90% reduction in TOC and Viscosity).
- Volume of sludge varies from one test to another, however, for the best results the volume of sludge was low.
- With composition product operating window can be widen for pH.

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Thank you!

Questions?

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