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# Graded viscosity banks on the rear end of the polymer slug

*Tuesday, 1 June 2021 15:40 (15 minutes)*

One of the problems in EOR methods is the instability that occurs on the interface between two fluids with high viscosity contrast. The usage of viscous polymer agent can partially solve the problem by making the water-oil front stable. However the subsequent displacement of polymer by water produce a lot of long thin "water fingers" on the rear end of the polymer slug. The breakthrough of the polymer slug reduces the oil recovery factor. In the talk we will discuss how to calculate the size of polymer slug and consider the technology of graded viscosity banks (GVB) which helps to reduce the amount of polymer mass without loss of it's effectiveness.

GVB technology was proposed by Claridge and consists in injecting several subsequent polymer slugs of decseasing concentrations. As viscosity ratio reduces, the instabilities start to grow slowly and one can inject less amount of polymer with the same positive effect on oil recovery.

The main assumption of GVB technology is the linear growth of the front and rear ends of the mixing zone. There are a lot of numerical works that confirm linear behavior of fingers at intermediate times, but unfortunately no rigorous results exist up to now. However it is possible to get pessimistic estimates on velocities of the mixing zone by analyzing the mathematical model of the miscible displacement (the so-called Peaceman model) under transverse flow equilibrium assumptions. Unlike the well-known Koval and Todd-Longstaff models, these estimates take into account not only the viscosity ratio, but the whole viscosity curve. I the talk we will give an overview of the existing models and present our results in this direction.

From practical point of view a natural question arises: "How many slugs should one inject?" To answer this question we calculate the amount of saved polymer for n slugs and prove a theorem that there exists a limiting injection profile as number of slugs tends to infinity. This gives an upper bound on the possible amount of saved polymer. Analyzing the result for different viscosity curves and finger velocity models we conclude that for many practical situations it is enough to inject 2-5 slugs.

We verify the GVB technology with our numerical experiments in DuMuX.

## Time Block Preference

Time Block A (09:00-12:00 CET)

## References

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**Primary authors:** Mr BAKHAREV, Fedor (Saint-Petersburg State University); Mr ENIN, Aleksandr (Saint-Petersburg State University); Mr TIKHOMIROV, Sergey (Saint-Petersburg State University); Mr KALININ, Konstantin (Saint-Petersburg State University); Mrs PETROVA, Yulia (Saint-Petersburg State University)

**Presenter:** Mrs PETROVA, Yulia (Saint-Petersburg State University)

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