Velocity enhancement models for polymer flooding in reservoir simulation

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Problem background

Polymer flooding is a well-known technique in enhanced oil recovery. After the first phase of depleting an oil reservoir typically water is injected in the reservoir to push more oil towards the oil producing wells. This is called water flooding. To further enhance the oil recovery a small amount of polymer may be added to the injection water. This is called polymer flooding.
It is well known that the polymer molecules, which are much larger than water molecules, actually travel faster through a porous medium than the water in which the polymer is dissolved. This effect is called velocity enhanced and various theories try to explain this phenomenon. In Hilden et al. [1] some simple models for this velocity enhancement effect are considered and compared. In particular, it is shown that the simplest model gives an ill-posed problem. However, the numerical results shown in the paper suggest that the models may not be entirely correct, since some of the solutions seem qualitatively different from experimental results.

Assignment
The goal of this assignment is to evaluate the models in this paper, and to see if further improvements can be made. The model and implementation will be in 1D, although extension to 2D can be done if time is available.
After a literature study on polymer flooding and its modelling, and in particular the modelling of the velocity enhancement effect, the models in [1] will be studied. After that a numerical model will be developed and implemented.

The assignment roughly consists of the following parts:

1. Review of existing dispersion models.
2. Theoretical aspects of dispersion.
3. Development of a numerical model.
4. Implementation and demonstration in a 1D model.
5. Possible extension to a 2D model.
6. Writing the thesis.

Literature

[1] S.T. Hilden; H.M. Nilsen; X. Raynaud: Study of the well-posedness of models for the inaccessible pore volume in polymer flooding. *Transp. Porous Media*, vol. 114, 2016, pp. 65–86.

[2] K.S. Sorbie: *Polymer-improved oil recovery*. Blackie, Glasgow, 1991.