Reasearch group on *Stability of Interfaces in Oil Recovery Phenomena*

IMAR Participants: G. Pasa
International Cooperations: France: Universite "Jean Monet" Saint Etienne
Workpackages involved: B2, C5.
Post-doctoral research: Dr. Olivier Titaud (Universite "Jean Monet" Saint Etienne) has spent 6 months as post-doctoral fellow at IMAR (3 months in 2002 and 3 more months in 2003). He has worked in the Continuous Media Mechanics group collaborating with Dr. G. Pasa (IMAR).

Scientific Objectives:

1. Study of interface's stability in Oil Recovery Process
2. Control of the eigenvalues of a particular Strum-Liouville problem.

Main Scientific Results:

1. G. Pasa: *Estimations for the Characteristic Values of a Sturm-Liouville problem*, ZAMP, 53(6), 973-979, 2002.
2. G. Pasa: *A new optimal formula for the growth constant in Hele-Shaw instability*, Transport In Porous Media, 49(1), 27-40, 2002.
3. G. Pasa: *Linear Stability in Oil recovery*, Rev. Roum. Math. Pures Appl., 48(2), 193-204, 2003.
4. C. Carasso, M. Panfilov, G. Pasa: *Flow of a fluid trough a fabric - the sweat problem*, Math. Reports, 5(55), 27-35, 2003.
5. G. Pasa, O. Titaud: *A class of viscosity profiles for oil displacement in porous media or Hele-Shaw cell*, accepted in Transport in Porous Media, ref. number TIPM 1853, 2004.

Research Activity:

The "secondar recovery" is the process in which a second immiscible fluid (usual water) is injected in the medium, pushing out the oil from a porous medium. A first approximation for the porous medium is the Hele-Shaw model, where an interfaces existes beteween the two fluids. If (as usual) the second fluid is less viscous, the interface is unstable (result given by Saffman and Taylor in 1958). An intermediate region i.r., containing a polymer surfactant, can be considered between water and oil. The viscosity in i.r. is a parameter, used to improve the stability, compared with the Saffman - Taylor case. The linear stability of interfaces is described by a Sturm-Liuoville problem, whose eigenvalues are the growth constant of perturbations.

- In [1] is proved the convergence for a method used to obtain an exponential optimal profile in i.r., given by Carasso and Pasa in 1998. In [2] a "very slow" exponential viscosity profile in i.r. is obtained. The growth constant is given by a new formula, improving the result of Saffman and Taylor.
- In [5] an exact method is used to obtain a *linear* optimal viscosity profile in i.r.. This profile needs less amount of polymer in i.r. for obtaining the same improvement of stability, compared with exponential profile.
- In [3] and [4] th interface stability is studied in the case of the *saturation* model, which is a more realistic description of a porous medium. The growth constant are obtained as function of wavenumber, according with some previous result.

Conferences:

1. G. Pasa, "Linear Stability in Secondary Oil Recovery", Proc. Conf. "Modern Approaches in Porous Media", Moscova, Rusia, summer 1999.
2. G. Pasa, "A new form of the permeability tensor of a periodic porous medium", Conf. Homog. Mult. Scales, Timisoara, Romania, summer 2001.
3. G. Pasa, " A very slow viscosity profile in the control of oil recovery stability", Conf. Franco - Chiliana Appl. Mathematics,, Santiago, Chile, december 2001.
4. G. Pasa, "The optimal control of Saffman-Taylor instability", Proc. Conf. "Anal. Optimiz. and Diff. Systems", Constanta, Romania, summer 2002.
5. G. Pasa, "Some results in control of Hele-Shaw instability", Conf. Homog. and oil recovery, Univ. Saint-Etienne, France, december 2003.