

Showalter, R. E.; Stefanelli, U.

Diffusion in poro-plastic media. (English) Zbl 1095.74011
Math. Methods Appl. Sci. 27, No. 18, 2131-2151 (2004).

Summary: A model is developed for the flow of a slightly compressible fluid through a saturated inelastic porous medium. The initial-boundary value problem is a system that consists of the diffusion equation for the fluid coupled to the momentum equation for the porous solid together with a constitutive law which includes a possibly hysteretic relation of elasto-viscoplastic type. The variational form of this problem in Hilbert space is a nonlinear evolution equation for which the existence and uniqueness of a global strong solution is proved by means of monotonicity methods. Various degenerate situations are permitted, such as incompressible fluid, negligible porosity, or a quasi-static momentum equation. The essential sufficient conditions for the well-posedness of the system consist of an ellipticity condition on the term for diffusion of fluid and either a viscous or a hardening assumption in the constitutive relation for the porous solid.

MSC:

- 74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.) Cited in 12 Documents
- 74S05 Finite element methods applied to problems in solid mechanics
- 74H20 Existence of solutions of dynamical problems in solid mechanics
- 74H25 Uniqueness of solutions of dynamical problems in solid mechanics
- 35Q72 Other PDE from mechanics (MSC2000)
- 74C10 Small-strain, rate-dependent theories of plasticity (including theories of viscoplasticity)
- 76R50 Diffusion

Keywords:

slightly compressible fluid; nonlinear evolution equation; existence; uniqueness

Full Text: [DOI](#)

References:

- [1] Sobolev spaces. Pure and Applied Mathematics, vol. 65. Academic Press: New York, 1975.
- [2] Auriault, *Journal de Mécanique* 16 pp 575– (1977)
- [3] Babuška, *RAIRO Modélisation Mathématique et Analyse Numérique* 32 pp 521– (1998)
- [4] Biot, *Journal of Applied Physics* 12 pp 155– (1941)
- [5] Biot, *Journal of Applied Physics* 26 pp 182– (1955)
- [6] Biot, *Indiana University Mathematics Journal* 21 pp 597– (1971)
- [7] Burridge, *Journal of Acoustic Society of America* 70 pp 1140– (1981)
- [8] Linear thermoelasticity. In *Handbuch der Physik*, vol. VIa/2. Springer: New York, 1972.
- [9] Singular and Degenerate Cauchy Problems. Academic Press: New York, 1976.
- [10] Rock mechanics. vol. 1, Theoretical Fundamentals, Editions Technip: Paris, 1991.
- [11] A numerical algorithm for single phase fluid flow in elastic porous media. In *Lecture Notes in Physics*, vol. 552. Springer: Berlin, 2000; 80-92. · [Zbl 1018.74037](#)
- [12] Coussy, *Transport in Porous Media* 4 pp 281– (1989) · [Zbl 0674.73005](#)
- [13] Dafermos, *Archives of Rational Mechanics and Analysis* 29 pp 241– (1968)
- [14] Heat Conduction within Linear Thermoelasticity. Springer: New York, 1985. · [Zbl 0577.73009](#) · [doi:10.1007/978-1-4613-9555-3](#)
- [15] Inequalities in mechanics and physics. *Grundlehren der Mathematischen Wissenschaften*, vol. 219. Springer-Verlag: Berlin, 1976.
- [16] Fichera, *Archives of Mechanics* 26 pp 903– (1974)
- [17] Plasticity: mathematical theory and numerical analysis. *Interdisciplinary Applied Mathematics*, vol. 9. Springer-Verlag: New York, 1999. · [Zbl 0926.74001](#)

- [18] Hollingsworth, *Discrete and Continuous Dynamical Systems* 1 pp 59– (1995)
- [19] *Computational Methods in Subsurface Flow*. Academic Press: New York, 1983. · [Zbl 0577.76001](#)
- [20] Johnson, *Journal de Mathematiques Pures et Appliquees* (9) 55 pp 431– (1976)
- [21] Johnson, *Journal de Mathematiques Pures et Appliquees* 62 pp 325– (1978)
- [22] *Hysteresis, Convexity and Dissipation in Hyperbolic Equations*. Gakkot?sho: Tokyo, 1996.
- [23] *Three-dimensional Problems of the Mathematical Theory of Elasticity and Thermoelasticity*. North-Holland: Amsterdam, 1979.
- [24] Lewis, *International Journal of Numerical and Analytical Methods in Geomechanics* 17 pp 577– (1993)
- [25] Li, *SIAM Journal on Numerical Analysis* 33 pp 809– (1996)
- [26] *Non-homogeneous boundary value problems and applications*. die Grundlehren der Mathematischen Wissenschaften, Band 181, vol. 1. Springer-Verlag: New York, Heidelberg, 1972.
- [27] Coupled geomechanics and flow simulation for time-lapse seismic modeling. In *Proceedings of the 69th Annual International Meeting of the Society of Exploration Geophysicists*, Houston, TX, 1999; 1667-1670.
- [28] Coupling of geomechanics and reservoir simulation models. In *Computer Methods and Advances in Geomechanics*, 1994; 2151-2158.
- [29] Murad, *International Journal of Engineering Science* 34 pp 313– (1996)
- [30] Rice, *Reviews in Geophysics and Space Physics* 14 pp 227– (1976)
- [31] Rockafellar, *Pacific Journal of Mathematics* 24 pp 525– (1968) · [Zbl 0159.43804](#) · [doi:10.2140/pjm.1968.24.525](#)
- [32] Rockafellar, *Journal of Mathematical Analysis in Applications* 28 pp 4– (1969)
- [33] Convex integral functionals and duality. In *Contributions to Nonlinear Functional Analysis*. (ed.). Academic Press: New York, 1971; 215-236. · [doi:10.1016/B978-0-12-775850-3.50012-1](#)
- [34] (ed.). *Mechanics of poroelastic media*. Solid Mechanics and its Applications, vol. 35. Kluwer Acad. Pub.: Dordrecht, 1996.
- [35] *Monotone operators in banach space and nonlinear differential equations*. Mathematical Surveys and Monographs, vol. 49. American Mathematical Society: Providence, 1997.
- [36] Showalter, *Journal of Mathematical Analysis and Applications* 251 pp 310– (2000)
- [37] Showalter, *Dynamics of Continuous, Discrete and Impulsive Systems* 10 pp 661– (2003)
- [38] Showalter, *Mathematical Methods in Applied Science* 25 pp 115– (2002)
- [39] Showalter, *Journal of Mathematical Analysis and Applications* 216 pp 218– (1997)
- [40] Showalter, *Discrete and Continuous Dynamical Systems (Ser. B: Applications and Algorithms)* 1 pp 403– (2001)
- [41] Partially saturated flow in a composite poroelastic medium. In *Poromechanics II*, et al. (eds.). Balkema: Lisse, 2002; 549-554.
- [42] *Computational inelasticity*. Interdisciplinary Applied Mathematics, vol. 7. Springer-Verlag: New York, 1998.
- [43] Suquet, *Quarterly Applied Mathematics* 38 pp 391– (1980)
- [44] *Erdbaumechanik auf Bodenphysikalischer Grundlage*. Franz Deuticke: Leipzig, 1925.
- [45] Differential models of hysteresis. *Applied Mathematical Sciences*, vol. 111. Springer: Berlin, 1994. · [Zbl 0820.35004](#)
- [46] ?eni?ek, *RAIRO Modélisation Mathématique et Analyse Numérique* 18 pp 183– (1984)
- [47] *Computational Geomechanics*. Wiley: Chichester, 1999.
- [48] Zienkiewicz, *Geotechnique* 30 pp 385– (1980)

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.