Long-term dynamics for well productivity index for nonlinear flows in porous media

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ABSTRACT. Motivated by the reservoir engineering concept of the well Productivity Index (PI) we study a time dependent functional for general non-linear Forchheimer equation. PI of the well characterizes the well capacity with respect to drainage area of the well. Unlike the linear case for which this concept is well developed, there are only a few recent publications dedicated to the PI for nonlinear case. In this paper the PI is comprehensively studied both theoretically and numerically. The impact of the nonlinearity of the flow filtration on the value of the PI is analyzed. Exact formula for the so called "skin factor" in radial case is derived depending on the rate of the flow, the order of nonlinearity and the geometric parameters. Numerical simulations sustain theoretical results.