Comment on hess-2021-588
Anonymous Referee #1

Referee comment on "Experimental study of non-Darcy flow characteristics in permeable stones" by Zhongxia Li et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-588-RC1, 2021

Dear Editor:

I have completed the review of the manuscript entitled “Experimental study of non-Darcian flow characteristics in permeable stones” submitted to HESS for potential publication. In my experience, experimental research on non-Darcy flow is never out of data. In this manuscript, firstly, the seepage experiment of permeable stone provides experimental basis for non-Darcian seepage in relatively low permeability medium; then, pore distribution characteristics of various permeable stones are analyzed by mercury injection test with Gaussian distribution function; finally, the influences of particle size and porosity on Forchheimer equation coefficient are investigated and some interesting phenomena are found. This manuscript has potential to provide hints for non-Darcy studies, in terms of such as critical values of non-Darcy flow, influences of pore properties on non-Darcy flow in some specific views and enlightenment of some special phenomena. At this stage, I will recommend a minor revision since there are still some deficiencies that need to improve in this manuscript as follows:

- Line 159: The basic information of permeable stone related to the manuscript topic, such as forming background and porous properties or generation, should be introduced firstly.
- Line 226: As Fig. 4 indicates, the best-fitting yields Forchheimer numbers \( F_0 = \frac{B}{A} = \frac{k\beta p v}{\mu} \) with orders of magnitudes to be about -4, but Zeng and Grigg (2006) suggested a critical \( F_0 \) to be 0.11 to trigger high-velocity non-Darcian flow, which makes the flow in authors’ seepage experiment looks like "super-weak non-Darcian type". If so, the authors should compare the best-fitting performances between Forchheimer equation and simple Darcy’s law, to prove the necessity of existence of the inertial term of \( Bq^2 \).
Fig. 4: The results of best-fitting by Forchheimer equation have unconspicuous connection with the subsequent discussion of "pseudo" hydraulic conductivity and critical specific discharge.

Lines 299-300: The pressure ratio is a macroscopic parameter but the inhomogeneity is a relatively microscopic one, so the authors should prove the reasonability of $P_C/P_B$ representing the inhomogeneity.

Equations (3-3) to (3-7) can be assembled into a single table for the purpose of more concise expression.

References should be provided for Equation (3-8). Eq. (3-8) cannot be derived from Eq. (1-2) alone.