Thus

$$\tau = \frac{\frac{\pi}{8} C_D \frac{1}{2} \rho u^2}{1 + B\left(\frac{\frac{1}{2}\rho u^2}{p_s - p_v}\right)}$$

$$= \frac{\mu_w (p_s - p_v)}{1 + \left(\frac{p_s - p_v}{\frac{B}{2} \rho u^2}\right)} \quad , \tag{12}$$

where μ_w is a dimensionless coefficient involving B and C_D:

$$\mu_w = \frac{\pi C_D}{8B} \quad . \tag{13}$$

The model equation (12) is consistent, of course, with the more general expression (11).

The constant B is approximately 0.5 according to [8], so the bracketed quantity in the denominator of (12) is about 4.0 d/R, generally rather small compared with unity, and very much smaller than unity if the inequalities (5) are taken seriously. A remarkably simple friction law follows,

$$\tau = \mu_w (p_s - p_v) \tag{14}$$

within the domain of validity for this theory. The water exerts <u>Coulomb friction</u> upon the rock, a friction proportional to normal pressure but independent of flow speed. The absence of u in (14) may seem paradoxical, since the surface stress τ is due entirely to ram impact of water against the grains. Clearly τ should equal zero when u does. The original friction law (12) involves u and implies that τ and u go to zero simultaneously. Under conditions of strong cavitation, however, an increase in u decreases the contact between water and grains, and the decreased contact exactly compensates the increased dynamic pressure.

Equation (13) permits a rough estimate of μ_w. The constant B is about 0.5 as mentioned before, and C_D is about 0.4 for cavitational flow around a sphere and 0.8 for a flat disc [9]. The drag of an irregular grain should lie somewhere between that of a sphere and a disc, so the coefficient of Coulomb friction is