7. Comparison with Experiment

Equation (28) is truly predictive, because all the parameters on the right-hand side can be measured prior to a rock-cutting experiment. The four material properties entering the definition of c are measureable by conventional means. Only μ_w is novel, and μ_w could be found by measuring the drag of a rough cavitating surface in a pressurized water tunnel, and reducing the data in terms of equation (14). Perhaps μ_w should be adjusted to absorb the discrepancy between the square jet assumed in the theory and the round jets used in practice, but μ_w is nearly universal and can be measured once and for all.

An experimental program is being formulated to test the predictions of (28). Meanwhile Olsen and Thomas have performed experiments to establish the plausibility of (28), in the absence of independent means to measure μ_w and some of the ingredients of c.

The operating conditions for the water jet were as follows:

$$d_o = 0.030 \text{ inch},$$

$$P_o = 17{,}000 \text{ psi},$$

$$\theta_o = 90°,$$

$$v = 1 \text{ to } 400 \text{ in/sec}.$$

The nozzle consisted of a 45° conical contraction followed by a 0.060 inch straight section of diameter 0.030 inch, not a particularly good geometry according to [3]. Feed rates below 10 in/sec were accomplished by a single rectilinear pass. The target rock was spun on a turntable for higher feed rates. The number of revolutions was chosen so that the accumulated depth of cut was about 0.5 inch, deep enough for accurate measurement. The nozzle exit was located within 0.5 inch of the target to minimize breakup of the jet stream.

The target was Wilkeson sandstone, quarried in Western Washington State. The properties of the sandstone are taken to be as follows:

$$\mu_r = 1.0,$$

$$\tau_o = 1000 \text{ psi},$$

$$g = 0.005 \text{ inch},$$

$$k = 8.6 \times 10^{-5} \text{(in/sec)/(psi/in)},$$

$$c = 17.2 \text{ in/sec}.$$