CRATER SIMULATIONS IN SUBSCALE JOINTED ROCK: PRELIMINARY RESULTS

Robert M. Schmidt, M/S 3H-29, Boeing Aerospace and Electronics, Seattle WA 98124

There is much conjecture about the effect of joint spacing on the effective strength of rock and its consequences on scaling. To date, all impact experiments in rock have been conducted in small, and therefore rather homogeneous, samples. The problem with such experiments is that they don't correctly model the joint/fracture characteristics of rocky materials involved in large scale impacts. In order to simulate large events, it is necessary to fabricate samples which are fractured at the appropriate spacing and have the low porosity associated with rock. This requirement has presented a difficult experimental hurdle. The approach being investigated here is to use targets consisting of layers of prefractured tempered glass plates. The layers provide a controlled vertical spacing of fractures. Additionally, the plates can be prefractured with a small explosive charge buried deep enough so as not to significantly disturb the sample surface. This abstract presents a summary of some preliminary experiments designed to test this method of sample fabrication. Seven impact tests have been performed, some using prefractured glass plates and some using "virgin" plates for comparison.

Brief description of experiments: All impactors were 6.35 mm diameter. 763-IAGS Al sphere, 3.6 km/s, 1G. Target was alternating layers of 2.3 mm thick annealed glass and 1.5 mm thick layers of basalt fines that passed a #100 sieve. Test of virgin glass soil model. 764-1762 Al sphere, 3.5 km/s, 1G. Target same as shot 763, but had been rubblized by a buried charge forming a crater which was later filled back in. Provided a comparison of rubblized targets with virgin glass soil model. 766-1764 Al cylinder, 1.8 km/s, 1G into same rubblized target as shot 764 above, where again the crater was filled back in. Tested effect of impact velocity on rubblized target. 770-1766 Al cylinder, 1.9 km/s and 523G into same rubblized target as shot 766 above, where the crater was yet again filled back in. Tested effect of gravity on rubblized target. 767-1765 Al cylinder, 1.7 km/s, 1G. Target was 3.3 mm thick layers of tempered glass, previously fractured but not cratered by a very deeply buried explosive charge. Only a slight mound was evident on the surface. Tested effect of prefracturing the glass model. 769-1768 Al cylinder, 1.8 km/s, 520G. Target prepared as described for 767. Test effect of gravity on prefractured glass. 771-IAGS Al cyl., 1.8 km/s, 520G. Target was 3.3 mm thick layers of virgin tempered glass. Compare with 769 for effect of prefracture.

The figure below shows how the cratering efficiency for the various shots compares with the previous results for dry sand and wet sand. It appears that interlocking of joints and block overturning might provide a significant strength even when materials are highly fractured.

To validate the suitability of any of the jointed rock simulants, comparison is also being made with existing explosive events that have been performed in rock in the field. Of particular interest is the cratering series conducted at Buckboard Mesa in a jointed basalt on the Nevada Test Site.

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System
ROCK CRATERS: Schmidt, R. M.

763-IAGS Virgin Annealed Glass/Soil 1G 3.6km/s Vol=15.1cc R=4.42 π2=8e-9 πv=101

764-1762 Rubble Annealed Glass/Soil 1G 3.5km/s Vol=86.3cc R=6.32 π2=8e-9 πv=508

766-1764 Rubble Annealed Glass/Soil 1G 1.8km/s Vol=45.6cc R=5.70 π2=3e-8 πv=187

770-1766 Rubble Annealed Glass/Soil 523G 1.9km/s Vol=12.2cc R=2.89 π2=2e-5 πv=50

767-1765 Fractured Tempered Glass 1G 1.7km/s Vol=32.8cc R=4.65 π2=4e-8 πv=143

769-1768 Fractured Tempered Glass 520G 1.8km/s Vol=15.6cc R=3.99 π2=2e-5 πv=68

771-IVTG Virgin Tempered Glass 520G 2.0km/s Vol=0.9cc R=1.59 π2=2e-5 πv=4.4