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A Two-Dimensional Investigation of Hydraulic Fracturing Principles

This research project was conducted to study principles behind hydraulic fracturing. Hydraulic fracturing, commonly known as 'fracking,' is used all around the country. It has greatly increased yields and profits in the oil and natural gas industries. I wanted to study fracking more in depth. More specifically, I wanted to investigate how increased pressures had an effect on fracturing.

To study this, I built an apparatus for the fracturing to be formed in. This included a Petri dish filled with a slurry of glass beads and water. The lid of the dish was inverted to contain the slurry without letting air out. A syringe was connected to the bottom of the dish to introduce air into the slurry. This airflow created the fracturing. In the apparatus, the slurry of glass beads represented a rock layer and the introduction point of air represented one perforation hole in a horizontal drill system.

Once the apparatus was constructed, experimentation could begin. This was done by introducing air into the slurry of glass beads and simultaneously taking pictures of the fractures forming. Pressures on the slurry were varied by changing masses placed on the top of the Petri dish. Multiple trials were run at differing pressures. Because a high speed camera was used, the picture depicting optimal formation could be obtained for each trial.

These pictures were then analyzed. The pictures were analyzed using different systems of grids. Both circular grids and rectangular grids were placed on the pictures to count the amount of grid sections occupied. The amount of occupied grid sections shows how much fracturing occurs. For each trial at each pressure the pictures were analyzed and the amount of grid sections occupied determined. Averages were then found.

The numbers were graphed and showed a general increase in amount of grid sections occupied for both small and large masses. This proved the hypothesis correct. If the model is applied to real life fracking, more fracturing would occur at greater depths underground. Drilling companies could increase yields and profits by selecting deeper plays of oil and natural gas.