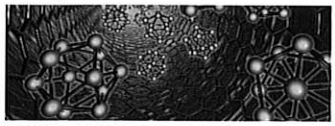
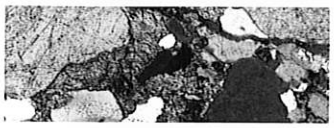











Cover photo: Purdue astronaut Jerry Ross spacewalking. See p. 70. Photo courtesy of NASA.

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Research advisor Santiago Pujol writes, "The famous structural engineer Hardy Cross said that all designs are based on experience. In this project, undergraduate students at Purdue University helped preserve data from the Chile earthquake of 2010. These data capture and share decades of experience accumulated by Chilean engineers working to reduce damage caused by earthquakes."

Biomass Hand-Press for Cameroon

Student researcher: Hannah Joy Pheasant, Junior

Many countries lack a sustainable supply of fuel for cooking or boiling unsafe water. Women can spend hours gathering wood to decrease the risk to their families from unsanitary water. To address the lack of cooking fuel, numerous NGOs have developed hand-presses to make low-cost, easily producible biomass briquettes to help reduce a dependence on wood as fuel and to utilize biomass material normally left to decompose. I conducted a comparative analysis of different hand-press designs and concluded that a design capable of producing higher pressure could utilize a wider range of biomass materials. I designed a prototype utilizing materials available in Africa so that the hand-presses could be built in-country to reduce cost and promote sustainability.

To test my prototype, banana peels and sawdust were soaked in water, then put into the hand-press and compressed to make briquettes. After drying for a day, the briquettes can be burned instead of firewood. Field testing was conducted in western Cameroon and results compared to a design in use in the area. My prototype did produce denser briquettes but took significantly more time to produce. While in Cameroon, I interviewed consumers about what criteria was most important to them and conducted market research on pricing and availability of hand-press materials.

Consumers were most concerned with the cost of the hand-press, the time to make briquettes, and briquette burn quality. The design I developed is low-cost and makes a dense briquette, which would burn well. However, these positives are countered by the fact that this prototype does not produce briquettes quickly.

Research advisor John Lumkes writes, "Lack of sustainable fuel is a problem in many areas of the world. It is used to sanitize water in many parts of Africa and India, and provide heating in urban areas of the Middle East. This project researched technical solutions that were evaluated by local end-users in a developing country context."

Design and Development of a High-Pressure Coal and Biomass Feeder

Student researcher: Yahui Wang, Senior

Coal and biomass pyrolysis and gasification has gained importance in the last few decades for synthetic fuel synthesis, which is a promising solution to the current energy crisis. Efficient fuel feed is necessary to the coal and biomass utilization processes. Common gasification systems employ large-scale slurry feeders to inject the fuel into the gasifier vessel. The presence of excess water in the slurry mixture demands a large energy input that reduces the overall process efficiencies. Dry feed systems are attractive alternatives to slurry feed systems to achieve higher efficiencies. However, high pressures inherent to most gasifier systems and difficulties with particle handling contribute to unpredictable mass flow rates. In this study, the behavior of coal and biomass dry feed has been investigated using a novel, motor-driven screw feeder designed to operate at high pressures. Experimental mass flow rate results were compared with existing theoretical models. The experiments were conducted for three types of feedstock: bituminous coal (< 150 μm), anthracite coal (< 44 μm), and coconut char (< 50 μm). The calibration study at high pressure shows repeatable results and close agreement with theoretical calculations. The results suggest that dry feeding of pulverized material under high-pressure conditions can be accomplished given careful optimization of the system parameters. This technology of high-pressure particle handling is extremely transformative and would ultimately benefit various industries including pharmaceuticals, biofuel refineries, and pulverized coal power plants.

Purdue University Calumet students Mariah Hood and Ryan Rosenbrock get distracted by online advertisements while working in the computer lab.