

## **IPRO 352: Abstract**

### **Tire Recycling for a Better Future**

#### **Objective**

To investigate the marketing potential of two IIT patented technologies directed at the rubber tire recycling industry.

#### **Problem**

Land filling of scrap tires causes serious environmental pollution and health problems. Scrap tires are petroleum-rich products, and when incinerated, release particulate pollutants into the atmosphere and hazardous chemicals into groundwater. Of the 290 million scrap tires generated in the United States in 2003, nearly one-fourth wound up in landfills<sup>1</sup>. This is in addition to the more than 300 million tires that are stockpiled across the country<sup>1</sup>. In an effort to address these problems, more than three-fourths of the 290 million scrap tires generated in the United States were subjected to recycling processing in 2003<sup>1</sup>.

Current recycling approaches focus on relatively unattractive, low-value means of disposal, including land filling and incineration. There is a clear need for economically sound alternatives for either environmentally benign tire disposal or for rubber reuse in existing or new commercial markets.

#### **Opportunity**

Cryogenic systems are most preferred when reducing the size of rubber chips as liquid nitrogen is used to “cool” the rubber during grinding. However, the cost of liquid nitrogen, \$0.02 - \$0.06/lb, depending on the location of the liquid nitrogen supplier, makes producing 60 – 100 mesh rubber particles very expensive<sup>4</sup>. Additionally, the cryogenic process produces a broad distribution of particle sizes. Thus, the cryogenic recycling firm requires sufficient markets (customers) for which to sell all mesh size output.

#### **Solution**

At the Illinois Institute of Technology (IIT), Dr. Fouad Teymour and Dr. Hammid Arastoopour patented a rubber pulverization process called solid-state shear extrusion (SSSE). At the heart of SSSE is a modified conventionally available screw compressor that pulverizes the rubber under high shear and compression forces, and operates at a controlled temperature<sup>2</sup>. Resultant particles have high surface area and are partially devulcanized<sup>3</sup> (breaking the carbon-sulfur bonds of rubber) with minimal degradation of the unique characteristics of the produced rubber powder, making them more suitable for further processing. A second proprietary technology, particulate phase interpenetrating polymer network (PPIP), is used to modify rubber particles such that they are able to absorb water, making them amphiphilic, and release the water at a controlled rate. Application into soil mediums results in a less frequent watering schedule. Our team incorporated these particles into water-based coatings and agricultural applications for further analysis.

#### **Key Tasks**

The team was divided into three groups with responsibilities as follows:  
Business Group

- Investigate the marketing potential of SSSE through conversations with consultants and industry participants
- Propose a business plan

#### Technical Group

- Produce SSSE particles and chemically modify them using PPIPn technology
- Test the modified rubber particles for feasibility in several proposed new applications, including water-based coatings and agricultural applications

#### Deliverables Group

- Create the website
- Manage reports, exhibits and other materials required for both EnPRO 352 and the ongoing EPA P3 award competition

### **Key Findings**

- Sufficient industry insight was gathered to understand the critical success factors, assess SSSE merits and recommend a commercial approach for the technology
- The feasibility of PPIPn materials in decorative wall coatings and non-slip floor surfaces were demonstrated
- The moisture-retention properties of PPIPn-modified particles in agricultural applications were reinforced in the plant studies

### **Next Steps**

IIT seeks funding to scale-up the extruder (SSSE) and PPIPn reactor technologies to provide a full-scale natural grass surface demonstration by seeking sponsorship with an athletic foundation such as the NFL. Both the SSSE and PPIPn are worthy of further marketing investigation and can be considered as independent opportunities, as either could exist in the market without the other.

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