A 21st Century approach to industrial polymer production, and its positive advantages for energy efficiency, reduced environmental impact, and job creation

About 25% of the $600 Billion per annum U.S. chemical industry is based on production of polymers and associated chemicals. Polymers are used in diverse fields, including resins, paints, adhesives, pharmaceuticals, natural products, food and agriculture, water treatment, oil recovery, etc. Thus, the value added to the raw polymeric materials is immense. The US chemical industry is the 2nd largest industrial consumer of energy. The chemical industry carbon emissions were 311 million metric tons in 2002, the highest of any manufacturing industry, at 22.2% of total manufacturing emissions. The polymer industry is a major consumer of petroleum, natural gas, and other non-renewable resources. This makes it an ideal target for efficiency gains to reduce dependence on foreign oil, and promote the energy security of the nation, goals falling squarely within the mission of the Department of Energy.

Employment in the sector has fallen dramatically from 883,000 jobs in 1998 to 576,000 in 2007. Many jobs and plants have left the US for other countries in recent years. Reasons for this include failure of US plants to comply with environmental regulations, insufficient profit margins due to inefficient production processes, and cheap labor overseas. This trend continues. The European Union is now funding a project, Ener-plast, specifically designed to increase energy efficiency in the European polymer industry. Unfortunately, this further demonstrates how the U.S. lags in increasing polymer industry efficiency.

At Tulane, Reed et al. have developed and patented a family of technologies, Automatic Continuous Online Monitoring of Polymerization reactions (ACOMP), which can lead to: 1) More efficient use of energy, petroleum-based and other non-renewable resources in polymeric materials manufacturing, 2) a leap in novel material properties, quality, versatility, yield, and applications, 3) less greenhouse gas emitted per pound of product, 4) less chemical contamination of soil, water, air and surrounding communities and 5) enhanced profitability due to efficiency and quality gains leading to 6) retention and expansion of this manufacturing sector in the US, together with its broad spectrum of blue and white collar jobs, and 7) a quantitative basis for evaluating energy efficiency of polymer manufacturing.

ACOMP’s applications have been proven (over 30 publications in top quality journals), and expanded since 1998. PolyRMC has many R&D collaborations with the industrial sector, both in the polymer industry and with instrumentation manufacturers. PolyRMC is now looking to transfer this technology more generally to polymer industries to achieve greater energy efficiency and increased productivity.

We believe these goals fit squarely into the DoE mission of promoting energy security for the nation, promoting R&D to “Strengthen U.S. scientific discovery, economic competitiveness, and improve quality of life through innovations in science and technology,” and finally environmental responsibility, as well as the added dimension of job retention/creation.

Path to achieving these goals.

Achieving these goals involves a dynamic Government-University-Industry collaboration. Industries are already extremely interested in online monitoring and control of polymerization reactions and are devoting resources to it, but in a fragmented and unorganized way. The government portion addresses the risks involved with developing a comprehensive, fundamental modular, polymerization reaction and control platform. PolyRMC already has a broad base of participating industries, and with Government support, specifically from the Department of Energy, the result could be profound, and vastly accelerate widespread industrial implementation with all the beneficial consequences proposed in this vision.

1 http://www.bls.gov/oco/cg/cgs008.htm
3 http://www.enerplast.eu/pgm/project.php
4 http://www.energy.gov/about/index.htm