Polymer Research @ CHE, KFUPM

Meeting with NPC

January 16, 2007

Drs. Abu Sharkh, Hussein; Al-Juhani

Outline

- Research Projects (Completed; In Progress)
- Reviewing
- Journal Publications
- Research Areas
- Polymer Research Facilities
- International Collaboration
- Possible areas of Collaboration with NPC

Completed Research Projects

1. Influence of Molecular Parameters on the Rheology and Miscibility of molten linear low-density polyethylene (LLDPE) in low-density polyethylene (LDPE) and high-density polyethylene (HDPE).

Drs. Hussein; Abu Sharkh; Mezghani

Funds: KFUPM

Budget SR 1.3 million

Period: April 2001-April 2004

Studied influence of different molecular parameters on miscibility of PE Blends

2. Investigation of Structure-Conformation Relationships in molten m-Polyethylenes by Rheological and Molecular Simulation Techniques,

Drs. Hussein; Abu Sharkh; Tukur

KFUPM-ARI Grant,

Budget **SR 75,000**,

Period: **Nov. 2002 – Dec. 2003.**

3. Rubbers

- NBR/HNBR blends: Degradation and compatibility.
- **Abu Sharkh; Hussein**

4. Composites

- **Palm Fiber-PP Composites**

- **Abu Sharkh; Kahraman**

- **Funds: KACST**
- **Period:**

5. Synthesis, Thermal, and Rheological Characterization of Composite Membranes for Fuel Cell Applications

- **Zaidi; Hussein**

Funds: KFUPM, Fast Track

Budget: SR75,000

Period: April 1, 2002 – February 29, 2004.

Completed Projects (cont.)

6. **A study to improve SABIC Polymers for the Performance Modification of Saudi-Asphalt binders”**

Al-Abdul Wahhab; Hussein

Funds: SABIC

Period: April 2003- Nov. 2004,

Budget: SR 240,000.

Completed Projects (cont.)

7. Water Soluble Polymers

Influence of Hydrophobe Content on the Solution Rheology of SO_2, N,N-diallyl-N-carboethoxymethylammonium chloride-co-N,N-diallyl-N-octadecylammonium chloride Polymer.

Abu Sharkh; Ali; Hussein; Al-Muallem

Funds: KFUPM

8. Rheology of Gelling Polymers used in Reservoir Water-Shutoff Treatment

- Viscoelastic Properties of a High Temperature Cross-linked Water Shut-Off Polymeric Gel
- Rheokinetic Study of an Organically Cross-linked Polymeric Gel Used for Water Shut-Off.

9. Influence of Tacticity and Mw on the Compatibility of PP/LDPE Blends: Rheological, Thermal, Mechanical, and Molecular Dynamics Simulation Study

Drs Hussein, Abu Sharkh

Funds: KFUPM, SABIC Grant, SR 75,000

Duration: July 2005- Nov 2006

10. Investigation of the Influence of Molecular Structure on Molecular Characteristics of metallocene LLDPE by NMR, Light Scattering, DSC, and MD Simulation Techniques,

Drs. Hussein; Abu Sharkh; Zaidi; Emmnuel

Funds; **KACST**

Budget: **SR 867,000**.

Period: **October 2003- September, 2006**

Projects (In Progress/Approved)

1. “Influence of Hydrophobe Architecture on Self Assembly, Rheology and Interfacial Properties of Amphiphilic ionic Polymers”, KFUPM, October 2005-September 2007.

2. “Development of Highly Conductive Composite Membranes for Medium Temperature PEM Fuel Cell”, KFUPM, Nov. 2005-April 2008, Budget SR 595,000.

3. Synthesis; Solution, Melt, and Solid-State Properties; and Modeling of Metallocene Polyolefins with Controlled Long Chain Branching, KFUPM, SR 418,000.

Drs. Hussein, Abu Shark, Soares

Funds: KFUPM

(Collaboration with Prof. Soares from University of Waterloo, Canada)

4. Active Site Identification, Mathematical Modeling, Rheological, Thermal and Mechanical Properties of Controlled Microstructure Polyolefins made with Ziegler-Natta Catalysts, KACST, SR 600,000

Hussein; Sunaidi; Soares

Will start Sept 2007

(Collaboration with Prof. Soares from University of Waterloo, Canada)
Similar objectives to the LCB project.

Modeling the Properties of ZN-LLDPEs

Reviewing

(Drs Abu Sharkh and Hussein)

About 15 different journals including:

- Macromolecules
- Polymer
- Polymer Engineering & Science
- Applied Polymer Science
- Journal of Rheology
- Rheologica Acta
- European Polymer Journal
- Macromolecular Materials Engineering
- Polymer International
- Polymer Bulletin
- Regional journal: GCC countries

Journal Publications

About 20 different journals including:

- Macromolecules
- Polymer
- Polymer Engineering & Science
- Applied Polymer Science
- Chemical Physics
- Rheologica Acta
- J. Non-Newtonian Fluid Mechanics
- Macromolecular Rapid Communication
- European Polymer Journal
- Macromolecular Materials Engineering
- Polymer International
- Petroleum Science & Engineering
- Canadian Journal of Chemical Engineering
- Polymer Research

Research Areas

More than 150 Journal and refereed conference publications:

Areas of Polymers Research at the CHE Department

1. Polyolefins (PE and PP)
2. Rheology
3. Molecular Simulations
4. Thermal analysis
5. Mechanical properties
6. Blends: PE/PE; PE/LDPE; NBR/HNBR
7. Water Soluble Polymers
8. Polymeric Gels and VES
9. Surface Science

New and Emerging Areas of Research

- Nanotechnology: with focus on the use of CNT, CNF, ZnO and nano clays for improving properties and Processing of Polyolefins.

Al-Juhani; Abu Sharkh; Hussein

Polymer Lab Facilities

- TA ARES controlled stress rheometer.
- TA Q 800 Dynamic Mechanical Analysis
- ACER capillary extrusion rheometer.
- Waters GPC
- Light scattering
- Q1000 modulated DSC
- Haake melt blender
- Instron machine
- Grinders and hydraulic cutters.
- Injection molding maching
- Stress crack measurement
- Twin screw extruder
- Production of Carbon Nano Tubes (in progress)

International Collaboration

- Prof. Joao Soares, Chemical Engineering Dept, university of Waterloo, Canada (Polymer Reaction Engineering).

- Professor Jose Covas, Chairman, department of Polymer Engineering, University of Minho, Portigal (Extrusion and Polymer processing).
- Prof. Josef Kocsis, Institute of Composite Materials, Univ of Kasalsrtern, Germany.

Possible Areas of Collaboration with NPC

- 1- We can provide **different training levels** to operators, engineers and quality assurance specialists. Training can include the areas of polymer technology, polymer analysis and general chemical engineering subjects.

  People that can participate in such training are: Drs. Hussein; Al-Juhani and Abu Sharkh

- 2- We can also provide **consulting on issues related to process**. We have experience in the processing aspect (pelletization part of the process). We can provide some consulting on the reactor side of the process using experience of our adjunct faculty Dr. Soares.

- 3- We can provide **consulting on issues related to quality**: This includes polymer analysis, additive analysis, xylene solubles analysis and spectroscopic analysis (NMR, FTIR).
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- 4- We can provide **research type services**, for example analysis of molecular weight and molecular weight distribution and rheological characterization. We can also do more fundamental type of research using experience of Professor Soares on reactor design, modeling and catalysis.
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- 5- We can provide **consultation regarding customer complaints** with regard to product quality/ processing and help in improving processability and properties of products.
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- 7- We can work with them to **establish their research capability and labs**.
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Thank You

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