

## Working together toward support and promotion of Green Chemistry: The Michigan story

Dr. Dalila Kovacs  
Grand Valley State University, Allendale, MI

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## Thanks to:

Robert Jackson, Karen Edlin, and Dale Copadge  
MIDEQ

Ms. Tracey Easthope - Ecology Center

## Green Chemistry / Sustainability: as a state-wide effort

### Legislative:

Massachusetts  
California

### Voluntary:

Michigan

Initially envisioned as support for economic growth

The screenshot shows the official website of the Michigan Office of the Governor, Governor Jennifer M. Granholm. The page features the state seal and navigation links. The main content area displays Executive Directive No. 2006-6, titled "PROMOTION OF GREEN CHEMISTRY FOR SUSTAINABLE ECONOMIC DEVELOPMENT AND PROTECTION OF PUBLIC HEALTH". The text of the directive is visible, starting with "WHEREAS, Section 1 of Article V of the Michigan Constitution of 1963 vests the executive power the State of Michigan in the Governor;". A sidebar on the left contains various links such as "Executive Directives", "Jobs Today, Jobs Tomorrow", and "Weekly Radio Addresses".

## Executive Directive

- Convene a **Green Chemistry Support Roundtable** to include representatives of public health, industrial, environmental, local government, education, and general public.
- Establish a **Green Chemistry Support Program** to promote and coordinate state-wide green chemistry research, development, demonstration, education, and technology transfer activities in Michigan.

## Goals: Identify...

- existing resources to support GC in MI
- pathways to access & share resources
- means to contribute
- viable routes to develop the integration of green chemistry in the main stream education program at all levels in MI and elsewhere

## Green Chemistry Roundtable Participants

### Companies Business & Consultants

- Dr. Patricia Beattie - **Arcalis Scientific**
- Mariann Anticoli- **General Motors**
- Mr. Jim Lowry - **BioSolutions, LLC**
- Dr. Clinton Boyd - **Sustainable Research Group**
- Mr. Michael Hales - **Dow Corning**
- Mr. Neil Hawkins and Dr. Anne Walin, **Dow Chemical**
- Mr. Andrew Such - **EnviroPolicy Consultants**
- Dr. Rawle Hollingsworth - **Afid Therapeutics, Inc.**
- Mr. Gabe Wing - **Herman Miller, Inc.**
- Mr. Guy Williams - **G.O. Williams & Associates, LLC**

## Green Chemistry Roundtable Participants

### Public interest and faith-based groups

- Ms. Tracey Easthope - **Ecology Center**
- Ms. Patty Gillis - **Voices for Earth Justice**
- Mr. Ted Schettler - **Science and Environmental Health Network**

## Green Chemistry Roundtable Participants

### Trade Associations

- Ms. Cynthia Zwick - Michigan Chemistry Council

### Chemists / University Representatives

- Dr. Yinlun Huang - Wayne State University
- Mr. Stephen Maldonado - University of Michigan
- Dr. Richard Rediske – Annis Water Research Institute
- Ms. Sarah Green - Michigan Technological University
- Dr. Dalila Kovacs – Grand Valley State University

## Green Chemistry Roundtable Participants

### State Agencies and County Representatives

- Mr. Robert Craig - **Michigan Department of Agriculture**
- Mr. Doug Parks - **Michigan Economic Development Corporation**
- Mr. Robert Jackson - **MI Dept. of Energy, Labor & Economic Growth**
- Dr. Rebecca Head - **Monroe County Health Department**
- Ms. Martha Stanbury - **Michigan Department of Community Health**



**Lowell Center** for Sustainable Production  
University of Massachusetts Lowell

Advancing Green Chemistry: An Action Plan for Michigan Research, Development and Education, *September, 2008*

Phased process:

- One: Building Awareness**
- Two: Building the Program**
- Three: Building the Future**



## Michigan Green Chemistry Governor's Award Program

Nomination Package for 2009 Awards

### Introduction

The Michigan Green Chemistry Governor's Award Program (Award Program) was established by the Michigan Green Chemistry Roundtable to recognize innovations in green chemistry.



**greenUp**  
Michigan Green Chemistry Conference

**Friday**  
**September 25, 2009**  
8 am - 5 pm  
Fort Shelby/Detroit  
Downtown DoubleTree

**1<sup>st</sup>**  
Annual

**Michigan Green Chemistry Conference will transform knowledge into action and action into results.** Leading experts in the field of technology, chemistry, engineering, and business process improvement will inspire and inform as Michigan business leaders develop an infrastructure for advancing and sustaining green products and processes.

This powerful event, initiated by Governor Jennit Granholm, will not only impact Michigan's critical environmental policies, but also our state's economy, and its overall health.

**Join those committed to moving Green Chemistry forward for Michigan!**

## 1st MI Green Chemistry Conference

- 160 attendees
- 16 break-out sessions
- Governor's green chemistry award: 26 nominations submitted
- 11 sponsors




### Business

**PPG Industries, Inc.**  
**Ray Schappert, PhD**  
Director, EMS & Growth Initiatives

**Contributors**

- Milo Abu, Research Associate
- Dave Boehmer, Director, Marketing and Technology
- John Boehmer, Manager, Technical Services
- Nang Bui, Product Manager

**Chittesen Enhanced Paint Detackifier GREEN LOGIC™**

GREEN LOGIC™ is a liquid, chitosan-containing, paint denaturant technology that provides an alternative to traditional methylene-formaldehyde (a suspect carcinogen) or acrylic acid based chemistries. The unique feature of the GREEN LOGIC™ technology is that it is derived from crab, lobster and shrimp shells that are a waste product of food production. The GREEN LOGIC™ technology has performed as well as and better in some cases than traditional products used in this area while providing significant cost savings and carbon footprint reduction advantages to customers.

Paint denaturants, also referred to as "paint detackifiers," are added to the water curtain circulating in down draft, water washed paint spray booths to render over sprayed paint non-dirty. In traditional automotive OEM wet paint spraying operations, only 50-60% of the paint is transferred to the vehicle, with the remaining 20-50% being deposited in the air knock stream that is later purified in the circulating water curtain. The chemicals added to the water curtain densify, coagulate and flocculate this over sprayed portion of paint allowing it to be later removed from the water in either a continuous or batch process. The currently available methylene-formaldehyde based detackifiers necessarily contain small amounts of residual free formaldehyde, a suspect carcinogen. Further, the acrylic acid based group of paint denaturants are originally derived from ethylene and/or propylene produced during the petroleum cracking process and therefore rely on non-renewable, petroleum based feed stocks. The pricing of these acrylic acid-based products is therefore subject to the demands of the petroleum market.

All research, development, education, advocacy, and implementation (including sales and marketing) of the GREEN LOGIC™ technology is through PPG Industries, Inc., Troy, Michigan.



### Academic

**Yinlun Huang, PhD**  
**Wayne State University**

Professor and Charles R. Goodwin Distinguished Faculty Fellow, Director, Graduate Program, Director, Laboratory for Molecular Complex Systems Science and Engineering, Department of Chemical Engineering and Materials Science, Co-Director, Sustainable Engineering Graduate Certificate Program, College of Engineering

**Contributors**

- National Science Foundation Financial
- Environmental Protection Agency Financial
- American Electroplaters and Surface Finishes Society Financial
- Michigan Department of Environmental Quality Financial
- K.C. Jones Plating Company Financial/Technical

**Integrated Hazardous Chemical-Metal Near-Zero Discharge Technology for Green and Profitable Design and Operation of Electroplating Processes**

According to American Electroplaters and Surface Finishes Society, Michigan has approximately 200 small electroplating plants. The plants consume huge amounts of hazardous/toxic chemicals daily for surface treatment and metal deposition on parts. The waste streams from production lines usually contain over 100 regulated chemical, metal, and other contaminants. Today, how to minimize the use of hazardous/toxic chemicals and their loss to the environment, to reduce production cost, and to ensure product quality are the most challenging issues for all the Michigan platers.

Over the past decade, Huang has led his research group to conduct comprehensive studies on hazardous substance-focused source reduction in the electroplating industry, with a promise of profit generation through technology implementation. The Integrated Hazardous Chemical-Metal Near-Zero Discharge (IHM-NZD) technology developed by Huang is an integration of two key technologies: (i) the hazardous chemical solvent/near-zero discharge technology through designing and operating a Stage-wise Chemical Absorption Network (SCAN), and (ii) the hazardous plating solution near-zero discharge technology through designing and operating a Reversed Electroplating Solution Reuse-System (RESORS).

The technology was successfully implemented at K.C. Jones Plating Company in 2007, with significant environmental and economic benefits. These include the reductions of hazardous chemical consumption by 6%-100% (depending on the chemicals), the hazardous substances entering to the environment by 83%-92%, and the rinse water by 40%, the plating solution consumption by 20%-45% (depending on the chemicals and metals). The ratio of the annualized profit from the technology to the total annualized cost for using the technology reached 16.3 to 1.

**Award Sponsored By: Herman Miller**



### Terephthalic Acid Synthesis in High-Temperature Liquid Water at High Concentrations

This technology replaces a flammable organic solvent with water. It also eliminates the production of methyl bromide pollution (about 25,000 lbs/yr/plant) from terephthalic acid synthesis and the need to synthesize about 1 billion lbs/yr of acetic acid as make up solvent. Thus, the environmental impacts associated with methyl bromide emissions and the manufacture of this acetic acid can be avoided. The potential global impact of a water-based process for making terephthalic acid is enormous. The investigators also developed and analyzed conceptual chemical process designs for this new reaction medium to show quantitatively that it is competitive on the bases of economics, energy consumption, and environmental impacts. The research also developed processing strategies so that high concentrations, such as those needed for a commercial process, could be used with these greener reaction conditions. Discovering how to get high terephthalic acid yields at high concentrations required extensive and sustained chemical research along with innovative strategies for feeding oxygen to the reactor. The University of Michigan has filed a provisional patent application for this technology and the discoveries have been published in several different peer-reviewed chemical journals.

The research has discovered reaction conditions and a reactor strategy for the synthesis of terephthalic acid in high yields and nearly 100% selectivity from catalyzed partial oxidation of p-xylene at high concentrations in high-temperature liquid water. Using water as an alternative medium for this reaction provides many benefits relative to acetic acid, the solvent used commercially. First of all, acetic acid is a flammable solvent whereas water is not. Furthermore, using water would eliminate emissions of the pollutant methyl bromide, which forms in the current process via reactions between acetic acid and the bromide catalysts employed. According to EPA's Toxics Release Inventory, a single

### Academic

**Phillip E. Savage, PhD, PE**  
**University of Michigan**

Arthur F. Thomas Professor, Chemical Engineering Department

**Contributors**

- Dr. Jennifer M. Durr
- Dr. Mitsumasa Osada



**Education  
Chemistry Department,  
Grand Valley State  
University**

**Contributors**  
Dr. Debra L. Kovacs, Associate  
Professor of Organic Chemistry  
Dr. Min Qi, Professor of  
Environmental Chemistry  
Dr. Andrew Lantz, Assistant  
Professor of Analytical Chemistry  
Dr. Cory DiCarlo, Assistant  
Professor Analytical Chemistry

**Green Chemistry Integration in the University Curriculum**

The work addresses the problem of content and methodology in green chemistry education in Michigan. Two green chemistry courses, a green chemistry certification and a strong environmental program place the Chemistry Department at Grand Valley State University (GVSU) at the forefront of green chemistry education in Michigan. As organizers of the 1st Michigan Green Chemistry Education Network conference and the publishers of *MI Green* newsletter, we are building the scaffold for a constructive and productive collaboration among institutions, state-wide, to the direct benefit of our students and the quality of future workforce in Michigan.

The interest in including Green Chemistry in the GVSU curriculum materialized initially in "Green Chemistry" a special topic class, highly evaluated by the students, resulting in a solid foundation for the new "Green Chemistry & Industrial process," a subject permanently enshrined in the curriculum. An introductory course, "Introduction Green Chemistry and Green Engineering" was designed via a service contract with Michigan Department of Environmental Quality.

GVSU offers a Bachelor of Science degree with an emphasis in Environmental Chemistry. This tradition, experienced faculty, and available equipment, converged extremely well with the new Green Chemistry courses and led to the inception of a Certification in green chemistry program currently under University Curriculum revision, a nodality to prepare our graduates for integration into the workforce and to provide them with a competitive edge for the job market. To fill the communication gap among Michigan educators and to share our experience, we organized a network conference, an event that brought together faculty, administrators, business and government representatives. The first issue of *MI Green*, a newsletter connecting all interested parties in green chemistry education was delivered. It will continue monthly, featuring idea exchange and cooperative projects.

**Award Sponsored By: Pfizer**



**MICHIGAN GREEN CHEMISTRY  
EDUCATION NEWSLETTER**

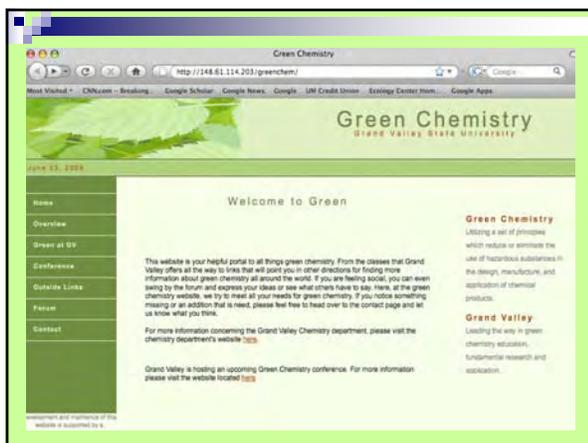
**JUNE 2009**

**2009 MI Green Chemistry Education Networking Conference**

On Friday May 8, the first Michigan Green Chemistry Education Networking Conference was held at Grand Valley State University. With financial support from the Michigan Department of Environmental Quality, this conference was designed to establish a network of educators who utilize or are interested in implementing green chemistry in their classrooms. The goals of organizing the annual one-day symposium are to build awareness and communication among educators in K-12 and higher education institutions and develop long-term plans to implement green chemistry curricula into classrooms and laboratories. In the end, the hope is to better prepare the future MI workforce and to promote and protect the state's economic, social, and environmental needs.



Over 70 educators, legislators, and industrial chemists from across the state of MI attended the conference, which was held at the GVSU Alumni House. Opening remarks were given by the GVSU Chemistry Department Chair Todd Carlson and faculty member Dalia Kovacs. The evening session consisted of several talks from individuals who have established green chemistry and pollution prevention courses recently. Jim Krinke of Grand Valley State presented his experience teaching a new general education Pollution Prevention and Green Processes course. This course was designed to introduce freshmen to the primary sources of pollution and how green chemistry and green engineering may be used to limit these sources. Senator Aurandt and Montserrat Rabago-Smith of Kenting University discussed the implementation of a green chemistry course to their department curriculum and the

Green Chemistry  
Grand Valley State University

June 13, 2009

Welcome to Green

**Green Chemistry**  
Utilizing a set of principles which reduce or minimize the use of hazardous substances in the design, manufacture and distribution of chemical products.

**Grand Valley**  
Leading the way in green chemistry education, fundamental research and application.

This website is your helpful portal to all things green chemistry. From the classes that Grand Valley offers all the way to links that will point you in other directions for finding more information about green chemistry all around the world. If you are feeling social, you can even bring to the forum and express your ideas or see what others have to say. Here, at the green chemistry website, we try to meet all your needs for green chemistry. If you notice something missing or an addition that is needed, please feel free to head over to the contact page and let us know what you think.

For more information concerning the Grand Valley Chemistry department, please visit the chemistry department's website [here](#).

Grand Valley is hosting an upcoming Green Chemistry conference. For more information please visit the website located [here](#).



Student Members of the American Chemical Society at the University of Michigan

<http://www.umich.edu/~acssa/green.html>

**Student Members of the American Chemical Society at the University of Michigan**

**GREEN CHEMISTRY**

Green chemistry seeks to protect the environment by preventing pollution and waste from the start. It operates under the theory that it is easier for us and better for the environment to design reactions to be more efficient with materials and energy, produce less harmful waste, and minimize the potential for accidents. SMACSUM is dedicated to promoting awareness and encouraging the use of the 12 principles of green chemistry. Each year a green chemistry newsletter is produced, highlighting the recent developments in this important field of study. Also green chemistry is highlighted with an awareness event in March on St. Patrick's Day. SMACSUM: Green Chemistry is open to participating in events with other environmental groups, as we believe that the environment is something we all must share responsibility for.

Click here to read the 2008-2009 issue of *Green Chemistry News!*

**THE TWELVE PRINCIPLES OF GREEN CHEMISTRY**

1. Prevent waste. Reduce chemical synthesis to prevent waste. Include an audit for each or



**BACKGROUND**

The Michigan Green Chemistry Program was created by Executive Directive, No. 2006-6, which also established a Green Chemistry Roundtable with representatives from public health, industrial, environmental, local government, and general public perspectives. The goal of the program is to promote green chemistry for sustainable economic development and protection of public health.

The Green Chemistry Program has responsibility for promoting and coordinating state green chemistry activities such as research, development, and demonstration, education, and technology transfer activities in Michigan. The objective is to foster use and development of new chemicals and chemical products that reduce or eliminate the use or generation of hazardous substances while producing high quality products through safe and efficient manufacturing processes.

As a result of the Executive Directive, the 1st Michigan Green Chemistry Conference took place in September, 2009. The conference brought over 160 attendees together to discuss ways to advance and sustain green products and processes in the State of Michigan. In addition to 13 individual breakout sessions, Dr. Amy Cannon presented a morning keynote on "What is Green Chemistry, and What it is Not". In the afternoon Dr. John Warner discussed opportunities and provided actionable ideas for Michigan organizations.

**CONFERENCE OVERVIEW**

This year, we will build upon the momentum from the 2009 conference and the green chemistry movement in Michigan. Specifically, we aim to:

1. Provide a balanced approach in content (introductory to expert) and format (lecture and case studies) on the value, future, and issues pertinent to green chemistry in Michigan.
2. Deliver tools, resources and content that drive green chemistry concepts into research, academia, industry and advocacy arenas.
3. Create such a rich and motivational experience that attendees take information and tools, and then act to change behavior in their organizations.
4. Create networking for knowledge sharing, development connections, and business opportunities.



**greenUp**

Focus areas include:

- Green Chemistry for Educators (what's happening in K-12 and University level)
- Manufacturing (auto, furniture, etc.)
- Chemical/pharmaceutical
- Policy
- Economic Development

For updated conference information, go to [www.michigan.gov/greenup](http://www.michigan.gov/greenup).

**PROPOSAL INFORMATION**

Proposals will be evaluated for:

- Relevance - meets conference objectives
- Technical quality
- Current/Cutting edge
- Providing solutions
- Preference will be given to Michigan organizations.
- Program must be strictly educational, providing fair, full disclosure and equitable balance of all aspects of a topic being presented. No endorsement, commercialism or selling will be permitted. All program materials must be free from promotional influence and/or marketing content.

**Progress Thus Far:**

- Four grants awarded to four universities to incorporate green chemistry into curriculum – GVSU, KU, MSU, and WSU.
- Michigan Green Chemistry Educators' Network created in 2009
  - 112 members in 2009
  - Conference held in May 2009 at GVSU
  - First Newsletter sent out in June 2009 – One total newsletters sent out
- Grant awarded to SAE to hold workshop considering an automotive industry green chemistry center
- Green Chemistry conference held in September 2009
  - Over 150 attendees
- Governor's Green Chemistry Awards held September 2009
  - 26 nominations submitted

**Other Progress :**

- Skyline High School in Ann Arbor has incorporated green chemistry into science curriculum
- Education and research efforts highlighted by Educator's Network Newsletter
- EPA award winners and nominations from Michigan
- House Bills No. 4817, 4818, 4819
- GVSU: certificate program

**In progress:**

- Initial research into green chemistry center in Ann Arbor, Midland, or Detroit
- RFP lunched in December 09; Grant to be awarded to build a green chemistry clearinghouse for the state

## Where do we go from here?

- Explore a sector-based Technology Transfer Center
- Explore a Green Chemistry Center
- Build a Resource Clearinghouse for Green Chemistry activities in the State (web portal)
- Expand Green Chemistry educational efforts to all levels of science education
- Improve Business – University collaboration
- Address some of the big environmental problems in the State
- Identify additional sources of funding
- Embed Green Chemistry in economic development strategy and funding

## Panelists

- Julie Haack  
Assistant Department Head,  
Chemistry, University of Oregon
  - Amy Cannon  
Co-founder and Executive Director  
Beyond Benign
- 
- Moderator: Dalila Kovacs  
Associate Professor  
Grand Valley State University, MI