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ACS Summer School in Green Chemistry and Sustainable Energy: fomenting awareness and creativity for innovative chemistry

FLORÊNCIO, T. M. [a*], MALPASS, G. R. P. [a],

a. Instituto de Ciências Exatas e Tecnológicas; Universidade Federal do Triângulo Mineiro, Uberaba, Minas Gerais, Brazil

**Corresponding author, thailamello@gmail.com*

Abstract

The concept and applications of Green Chemistry are not a novelty in countries with a well-established chemical industry and universities. Since awareness about sustainability and environment is increasing exponentially, investment in education and in academic areas is viable not only to foment research and development inside the scientific community but also to provide an exchange of ideas potentially applicable to achieve the goals implicit in the Twelve Principles of Green Chemistry. Remarkably, the American Chemical Society has been committed to Sustainable Energy and Green Chemistry since 2003, with an initiative of holding a series of meetings as Summer Schools gathering graduate students and postdocs involved with R&D in the areas of environment, green chemistry and sustainability with sponsorship of various foundations resulting in no cost for the accepted applicants. The Summer School happens every year and offers in one week lectures, applied exercises and interactive activities, enabling networking between representatives of industries, researchers and the students themselves. Even though applications are only accepted from students of the Americas, students from nationalities of all around the world who study in the Americas have attended the ACS Summer School.

Keywords: green chemistry, sustainability, sustainable energy, education.

1. Introduction

With the occurrence of accidents involving chemical industries and the emergence of environmental awareness, society holds a negative view of the chemical industry, even though the dependence of human beings on chemical-based products is complete. The chemist is responsible for the route of production of a certain substance or product and is aware of the risks, hazards and exposure of a determined methodology. Considering this, the chemist is capable of finding environmentally friendly ways to synthesize a substance or, if it is a dangerous one, to find less harmful, alternative substances. This idea can be summed up as Green Chemistry, environmentally benign chemical synthesis, alternative synthetic pathways for pollution prevention that are benign by design (ANASTAS, WARNER, 1998).

Green Chemistry relates to the use of already established principles (known as the twelve principles of green chemistry) in order to reduce and/or eliminate hazardous substances involved in the process of manufacturing, the design and application of chemical products, while aiming to optimize efficiency, economy and practical considerations.

While the diffusion of Green Chemistry might be well-established in some countries, many professionals and students have yet to discover the great benefits of this area, especially in developing countries, such as Brazil.

Although information is rapidly spread in the modern world, reliable sources are always needed. Recognizing this need and aiming to perform this task with excellence, the American Chemical Society, supported financially by their sponsors, meet the expectations of a great number of researchers and students, providing the "ACS Summer School on Green Chemistry & Sustainable Energy". The aim of this paper is to inform scientific and academic communities about the experience provided by the "ACS Summer School on Green Chemistry & Sustainable Energy", with background information provided by their representative Mary M. Kirchhoff, the benefits of this opportunity and how to apply.

2. The ACS Summer School background information

According to information provided, the series of Summer Schools began with the Pan-American Advanced Studies Institute (PASI) on Green Chemistry, held in Montevideo, Uruguay, during the period of 6th to 17th July, 2003. The program was sponsored by the National Science Foundation (NSF) and the Department of Energy (DOE) and engaged 17 instructors and 55 students from five countries in the Americas: Argentina, Brazil, Canada, United States of America and Uruguay.

In 2004, the program was held in Pittsburgh, PA, at Carnegie Mellon University. The event was sponsored by the American Chemical Society Petroleum Research Fund and involved 15 instructors and 62 students, who represented 23 countries. It is important to highlight that since then the number of applications has permanently exceeded the number of available places, thus revealing high worldwide interest in Green Chemistry as well as in Sustainable Energy. Remarkably, the area of renewable sources of energy and cleaner production has been in great development in both developed and developing countries.

By 2005, the Summer School was held at McGill University in Montréal, Québec, Canada, and was sponsored by the ExxonMobil Foundation. In 2006, the event took place at the headquarters of ACS, in Washington, DC, being sponsored primarily by the Johnson Family Foundation.

In 2007, the PASI on Sustainability and Green Chemistry happened in Mexico City at the Universidad Iberoamericana and the funds were provided by NSF, DOE and ExxonMobil.

From 2008 to 2010 the Summer Schools were held at the Colorado School of Mines, in Golden, CO. Support was provided by the Argosy Foundation in 2008, the Ciba Foundation in 2009, and the Petroleum Research Fund in 2010.

In 2011, the ACS Summer School was held once again at McGill University in Canada, also supported by the Petroleum Research Fund.

The 2012 edition of the ACS Summer School on Green Chemistry & Sustainable Energy returned to the Colorado School of Mines and the primary sponsor was also the Petroleum Research Fund. Support for all of the programs held in Colorado was also provided by the Colorado School of Mines, as well as by New Belgium Brewery. The 2012 Summer School engaged 55 students and postdocs.

3. Program Highlights and related benefits of participating in the ACS Summer

School on Green Chemistry & Sustainable Energy

According to the ACS (2012), the program highlights include presentations by leading researchers in green chemistry and sustainable energy; collaboration in solving problems and participating in laboratory experiments; research presentations during poster sessions; and engaging in discussions on the role of science and technology in solving global sustainability challenges.

It is important to highlight that the accepted students are provided with transportation, housing and meals, so they can participate at no cost for them. Also, cultural and personal information background is also taken into account (for instance, students who followed vegetarian diets could specify their restrictions). Interaction is highly recommended and encouraged, thus there are athletic and cultural activities.

Lectures from the last four years (2009 to 2012) are available on the ACS website. They aim to reach the students as future professionals in both the industrial and academic sectors. The common point is that being either the professional committed to chemical industry or to academia, this professional is committed to scientific excellence, taking into account that such a state can only be achieved when economical, social, environmental and practical aspects are in harmony – a state that both sustainability and green chemistry focus on.

The cultural diversity of varied nationalities contributes to foment discussions and achieve interesting conclusions about most diverse issues. Having both of the authors of the present paper attend the ACS Summer School in different years, their experiences show that each country has particular issues while dealing with their natural resources and when confronting such methods, the discussion leads to interactive and creative solutions and/or improvements. Noticeably, since the whole group is diverse in formation and in research themes – not to mention the fact that some are representatives of developed countries while others come from developing ones - the result of discussions gain deeper content as negative and positive points are raised and hence this "brainstorm" induces new research ideas, motivates connections, modifies one's thinking, and brings to light the problems faced by every community and how science can contribute to change this scenario.

Fig. 1. Joan Brennecke (University of Notre Dame) lectures at the Colorado School of Mines during the ACS Summer School in 2012.

4. How to apply

Information is available on ACS website (http://portal.acs.org/greenchemistry). A complete application requires five documents:

- Application form
- Transcript of graduate courses
- Letter of recommendation
- One-page
- Résumé or *curriculum vitae*

From 2013 on, it is required to register at a website in order to send all the files. Graduate students and postdoctoral scholars studying in the Americas can apply. The application period starts in January or February. For more information or questions please contact gceducation@acs.org.

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