

# Chemistry in Guatemala

by *Erick Estrada*

**G**uatemala, “the place of many trees”, is a small country in Central America with a rich history and biodiversity. Its most visible exports are fruits and flowers; sugar cane and coffee being a source of national pride.

Alongside the celebration of the 50th anniversary of the School of Chemistry in Guatemala City, the Second National Congress of Chemistry was held from 21-23 October 2015. Various entities were invited to participate, including IUPAC. We were pleased to receive Dr. Mark Cesa, who participated with the community of chemists in the country in all scheduled activities. Dr. Cesa informed us of IUPAC's activities and work in order to share information on innovation and progress related to chemistry. It was a great honor to have him here. He invited us to prepare this article presenting a brief review of the history of Chemistry in Guatemala to the international community, as well as the contributions and areas where chemists are involved. We are very excited to establish a relationship with chemists from all over the world to exchange information and work together based on shared experiences in all areas related to chemistry.

## History

After the Board of the Faculty of Chemistry and Pharmacy authorized the creation and operation of a program in chemistry on 23 October 1965, the University Council approved the curriculum of the last five terms of the program, a Bachelor's degree with 5 years duration. The first Director of the School of Chemistry was Miguel Angel Canga Argüelles. In 1981 the Chemical Industry Advisory Courses were implemented, providing services in the analysis of water, edible oils, lubricants, and cleaning products. Currently, the departments that make up the School of Chemistry are: General Chemistry, Inorganic Analysis, Organic Chemistry, Physical Chemistry, and Instrumental Analysis Lab.

The mission of the School of Chemistry is to contribute to the sustainable development of Guatemala through the training of professionals in Chemistry, with high academic standards, social conscience, and ability to perform in the national economy with excellence in different areas of chemistry. It also contributes to the generation of scientific knowledge and in the prevention and resolution of national problems through research and practice in the field of chemistry. The vision is to be the leading academic institution in the training

of chemistry professionals at national and regional levels, and in the scientific and technological research aimed at the physical and chemical transformation and sustainable use of the natural resources of Guatemala.

Currently, the curriculum consists of 48 courses (basic area, training area, applied area), distributed in 10 semesters (5 years) and culminating in qualification as a chemist in a Bachelor's degree upon completion of EPS (Supervised Professional Exercise) and Final Thesis Exam.

## Areas of Activity for Chemists

Over 40% of chemists work as teachers or professors in different colleges and universities. This is one of the greatest contributions that chemists make, preparing professionals from different careers in areas related to inorganic chemistry, organic chemistry, analytical chemistry and physical chemistry.

Chemists also work in the analysis of raw materials, formulation, research and development of products in the pharmaceutical, agrochemical, food, and natural products industries, activities where 28% of chemists are involved.

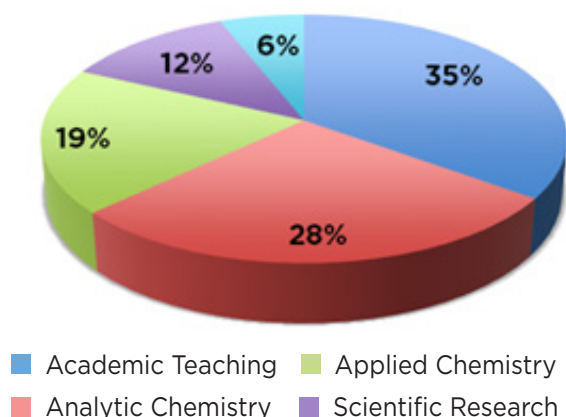
Guatemalans are proud to grow the best coffee in the world. George Washington, the inventor of instant coffee, was inspired and began his work in patenting the process during a sojourn in Guatemala around 1906.



*Coffee growing in Guatemala*

The sugar industry in Guatemala is recognized for its competitiveness within the region and globally. Guatemala is expected to continue as one of the most competitive sugar producers in the world, ranked as the tenth largest producer, fourth largest exporter, third most competitive, and, taking into account the carrying capacity of the port, one of the most efficient worldwide. Chemists working in laboratories are characterized by specialized high-tech equipment in various

## Where Chemists Work



sugar mills. By-products of sugar production process are the raw material for the production of biofuels such as bioethanol and biomass. Sugar mills contribute about a third of the country's electricity by burning bagasse. In February 2015 a pilot program for the use of ethanol in gasoline began with the support of the government of Brazil and the United States' Department of Energy. It seeks to provide 10% ethanol in all gasoline vehicles circulating in the country, requiring 36 million gallons a year. Currently in Guatemala five distilleries produce 65 million gallons of ethanol a year.

Analyses of water for household, agricultural, and industrial use; soil; and air are activities of great demand in the country throughout the year. The School of Chemistry has one instrumental analysis lab which provides chemical analytical services to Guatemalan society and the air monitoring unit of Guatemala City

since 1994, with the support of the Swiss Agency for Development and Cooperation (SDC). Air quality monitoring is carried out constantly throughout the year and the information is shared through an annual report that is published on the website of the University.

Mineral exploitation activities require the services of professionals in chemistry. Guatemala is a country rich in minerals and the mining industry has developed a high potential. Several studies have determined that deposits of gold, nickel, and other minerals are among the largest in Latin America. Added to this, Guatemala possesses unique deposits of jade. The Ministry of Mines and Energy has approved a total of 97 licenses and 493 exploration licenses. Currently there are 156 licenses in the process of being approved. Among the metallic minerals extracted are: gold, silver, nickel, iron, and copper. However, minerals such as lead, zinc, antimony, and tungsten can also be found in the country. In the case of non-metallic minerals, we can mention basalt and andesite, clay, white sand, bentonite, limestone, shale, feldspar, jade, marble, silica, gypsum, and others. Guatemala reported a total income of USD 26 million in 2014 in the marketing of these products. The main companies that extract these minerals are: Goldcorp. Inc., Tahoe Resources, and Cementos Progreso Solway Group (National).

The cement industry began operating in the country in 1899. Guatemala is one of the largest cement producers in the Latin American region, with an output of over 3 million tons a year.

### Value (FOB) exports of major export products related to the work field of chemists, (in million USD)

Product	2009	2010	2011	2012	2013	2014*
Sugar	507.7	726.7	648.8	803	941.9	951.7
Coffee	582.3	713.9	1174.2	958.1	714.5	667
Banana	414.8	353.3	475.3	499.8	594.7	652.4
Precious stones and metals	345.5	523.7	941.6	612.9	482.7	388
Pharmaceutical products	169.7	190.8	225.9	238.2	243.6	273.2
Alcoholic drinks and vinegar	185.7	199.9	222.9	321.5	338.2	341
Plastic materials	177.2	223.6	270.7	299.2	290.4	308.2
Edible fats and oils	164.4	201.3	330.9	361.0	361.8	379.1
Crude oil	191.7	247.2	335.4	291.7	277.3	277
Lead	2.1	4.2	5.6	4.6	35.9	353.1

Source: Guatemala on 2015 figures, Bank of Guatemala (Preliminary Figures)

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25% of chemists work as heads of laboratories and/or in administrative positions in the private sector and in government agencies such as the Ministry of Energy and Mines, Ministry of Environment, Ministry of Health, and Ministry of Agriculture. Some of their tasks include consulting and specialized consulting, active participation in environmental impact studies, and the import and marketing of chemical raw materials.

Oil exploitation in Guatemala is another area in which chemists have participated actively, for about 60 years. To date, 147 wells have been drilled. The annual production is approximately 17597 bbls/day from oil basins in the north. The oil is transported by pipeline to the terminal in Piedras Negras Santo Tomas de Castilla, Izabal, where it is exported for refining. There are currently five companies with active contracts for the exploration and exploitation of hydrocarbons: Perenco Guatemala Limited, Petro Energy SA, Petro Latina Corporation, Atlantic Oil Company, and US Oil Guatemala.

To this day, 225 chemists have graduated from the University of San Carlos of Guatemala (USAC) and 31 from the Universidad del Valle de Guatemala (UVG). About 30% have postgraduate studies at masters and doctoral levels. 15% of chemists live abroad, some temporarily, who are doing graduate studies, and others permanently.

Local chemists are actively involved in the development of scientific research projects on issues related to biotechnology, energy, environment, health, etc. Organizations like the National Council of Science and

Technology (CONCYT), DIGI, DG Research, and the Organization of American States (OAS), as well as friendly countries like Japan and Germany sponsor many of these studies, together with different universities in the country and in some cases with private initiatives. The available budget for these projects is very low and we need to increase cooperation with universities in other countries. We also need to follow up with the research so these works can be published in scientific journals to share the information collected. The number of published papers to date is very low.

Chemists have made significant contributions to the country's development and to solutions to national problems, through activities such as research and development in the field of biofuels; structural elucidation of molecules with potential anticancer activity; lobbying for a law to reduce emissions and air pollution; and research on water contaminants such as heavy metals, solvents, hydrocarbons, biocides, etc. that were carried out in major freshwater bodies to monitor the degree of drinkability and the availability for human consumption by the communities that depend on fishing and on the irrigation of plantations for their continued development. A mapping of radioactive contamination levels in soils and crops was made to determine the presence of elements such as cesium 137, which were found in hemp crop product after cross-contamination took place. Research related to computational chemistry has been undertaken since 2011, while specialized manufacturing equipment has also been developed in

### Welcoming New Members to IUPAC (and keeping our current ones!)

*by Mark Cesa, IUPAC Past President*

**W**hen I visited Prof. Estrada and his colleagues at the National Congress of Chemistry in Guatemala last October, I was impressed with the vitality of chemistry in the country and with the desire of chemists there to become better connected with the scientific world. It has been a privilege for me as an officer of IUPAC over the last four years to meet with chemists living and working in every continent except Antarctica (so far!), and I have found this same enthusiasm everywhere. In our new strategic plan, IUPAC's mission is to provide objective scientific expertise and develop the essential tools for the application and communication of chemical knowledge for the benefit of humankind and the world, and we strive for diversity and inclusiveness in all its forms. Therefore, it is all the more important now to help our membership grow, and to continually improve

the value we offer to our members. Whenever I have worked with chemists around the world, at symposia, congresses, or on teams developing new initiatives for the science, I have had in mind the goal to recruit new members. But I have also listened to the comments of our current members so that we can develop new ways of serving our membership and continue to provide value.

The Membership Relations Committee (MRC) is a committee of the IUPAC Bureau whose goal is to increase the membership of IUPAC and retain and support its current members. The MRC has worked with the Secretariat to compile and maintain active contacts with our member organizations (National Adhering Organizations, Associate National Adhering Organizations, Associated Organizations, and Company Associates), to speak at conferences and other meetings about the benefits of IUPAC membership, and to encourage chemistry organizations in countries new to IUPAC to join the Union. It has been successful in the past

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the area of instrumental multi elemental analysis, specifically infra-red and X-ray spectroscopy.

As a country, Guatemala has made contributions to chemistry in the development of the formulation of instant coffee and of incaparina, a food supplement drink considered important as an integral solution to the problem of malnutrition in Guatemala and widely accepted nationally and international.

Currently, the career of Chemistry at the University of San Carlos of Guatemala is in the process of accreditation for recognition abroad. For more information, please visit [http://sitios.usac.edu.gt/wp\\_eccquimicas/](http://sitios.usac.edu.gt/wp_eccquimicas/).

There is no professional association of Chemists currently, but work is being done to establish one.

Guatemala is a country whose geographic location

has unparalleled wealth in biodiversity of flora and fauna, which is a vast source of information for the development of research projects related to the study of medicinal plants, plants with the capacity to meet the food needs of a growing population, development of biofuels, biodegradable materials, etc. And because of its location, marketing and distribution of raw materials, reagents and equipment for the chemical industry in general is favored in Latin America and the Caribbean. 🏆

**Erick Estrada Giovanni Palencia** <[erickestrada.gt@gmail.com](mailto:erickestrada.gt@gmail.com)> is a Professor in the Department of Organic Chemistry, Faculty of Chemistry and Pharmacy, at the University of San Carlos of Guatemala.



*Participants at the celebration of the 50th anniversary of the School of Chemistry and the Second National Congress of Chemistry, in Guatemala City, 21-23 October 2015. Mark Cesa and Erik Estrada appear on the far right of the front row.*

decade, as our membership has grown to fifty-seven NAOs and more than thirty Associated Organizations.

In this biennium the MRC will be expanding its focus to ensure that our current member base is well served. We also want to make it easier and more attractive for individual persons to become affiliates; we want to welcome and retain more young chemists, women, and professionals in related sciences; and we want to identify and work with associated organizations with whom collaboration helps meet our strategic goals.

To do this we will be developing a strong value proposition for IUPAC, a statement that explains how IUPAC serves the needs of our member organizations, volunteers, and individual chemists around the world; how it delivers specific benefits or value to them to meet these needs; and why prospective new members and our current members should join IUPAC and stay with the Union. We want to show compellingly why organizations and individuals in countries everywhere around the world should become members, even in times when economic conditions are difficult.

To accomplish these goals we will need to think creatively. We will be exploring options for new ways to recruit individuals and organizations, including possibly new categories of membership; new services that can add value; and improved and more effective communications with chemists and chemistry organizations around the world. We will be seeking the opinions of our current and prospective members, as we did when we developed the new strategic plan. To serve our members effectively we must know what they need from IUPAC so that we can provide scientific expertise that addresses critical world needs and respond effectively to the rapidly changing and evolving world of science.

So we need your ideas. Please contact the IUPAC Secretariat at [secretariat@iupac.org](mailto:secretariat@iupac.org) or me at [mcesa@iupac.org](mailto:mcesa@iupac.org) with your thoughts on how IUPAC can be even more effective in the coming years. Our aim is to grow in value and effectiveness for chemistry around the world as the indispensable resource for chemistry. 🏆