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Foreword

1. Introduction

Counter-current Chromatography (CCC) is a unique liquid–liquid partition technique with a support-free liquid stationary phase [1]. There are two kinds of CCC columns. The hydrodynamic CCC column is a long piece of tubing which is wound on a drum that rotates in a planetary motion. This motion sets up a centrifugal force field which holds one liquid phase stationary against the flow of the other phase through zones of mixing and settling along the length of the column. In contrast, the hydrostatic column is made with a number of interconnected channels placed in a centrifuge rotor. The fact that the stationary phase is a liquid gives the process increased sample capacity, and the ability to tolerate particles. It also gives the process huge versatility as either phase can be the mobile phase and there is no loss of sample on a solid support since it does not exist and the retained liquid stationary phase can be pumped out of the column at the end of a run. CCC can be used for a variety of applications such as the separation and purification of natural products, inorganic elements, dyes, pharmaceuticals, agrochemicals, synthetic products, amino acids, peptides and proteins. The operation and applications range from analytical to process scale (from micrograms to tens of grams).

2. Pre-conference short-course

Due to the rapid growth and increasing interest in CCC technology, the organizers of CCC2010 offered, following the trend initiated at CCC2008 in Brazil, a two-day pre-conference program, with theoretical and practical content. The main goal of this activity was to give an overview of the technique and show the basic theory so that new researchers could become acquainted with the technique and have a better understanding of the presentations at the follow-on CCC2010 conference. The pre-conference short-course took place on the University of Lyon 1 Campus de la Doua using the school and lab space of the Master of Analysis and Control (Manco http://master-analyse-controle.univ-lyon1.fr/) on July 26 and 27, 2010. Ten participants attended. There were professionals and graduate students from different countries (Table 1).

The course was taught by the CCC2010 chairman Alain Berthod (Université de Lyon, France) helped by the CCC2008 chairman Gilda G. Leitão (Nucleo de Pesquisas de Produtos Naturais, UFRJ, Rio, Brazil). The first morning was dedicated to lectures presenting the CCC technique, its basic principles and the biphasic liquid systems. The afternoon was dedicated to practical experiments on three different CCC columns: a Kromaton FCPC® 200 mL hydrostatic instrument (Kromaton, Rousselet-Robatel, 39 rue Cugnot, 49130 Sainte Gemmes sur Loire, France, http://kromaton.com/); an Armen SCPC 100 mL hydrostatic instrument equipped with an automated injection, pumping, detection and collection system (Armen Instruments, 16 rue Ampère, 56890 Saint Ave., France, http://www.armen-instrument.com/); and a Spectrum® hydrodynamic CCC column with volume varying between 18 mL and 175 mL combining four different columns coiled on two drums rotating in a planetary motion in a sound and temperature insulated box (Dynamic Extraction, 890 Plymouth Road, Slough, SL1 4LP, UK, http://www.dynamicextractions.com/).

Similarly, the morning of the second day (July 27) was occupied by lectures on the original uses of a liquid stationary phase, presentation of the commercially available CCC columns, and examples of purification of natural and organic products. The afternoon was dedicated to the extraction of piperine from table black pepper and the analysis of a sample brought by a participant. Questions and various CCC problems were discussed to conclude the short course.

3. Conference

The 6th International Conference on Countercurrent Chromatography (CCC2010) was held on the La Doua Campus of the University of Lyon located in the Lyon's adjacent city of Villeurbanne on three days, July 28–30, 2010. The Institut des Sciences et Techniques de l'Ingenieur de Lyon (ISTIL) allowed us to use its building free of students at the conference time. At the CCC2008 symposium in Rio, the international committee decided that some geographical rotation of the CCC symposium venue was desirable and Europe was the selected continent for the coming 2010 venue. France and the proposal of Berthod and Marston[1] (University of Geneva, Switzerland) for an organization in Lyon were selected. It occurred exactly 10 years after CCC2000, the first Conference held in London and chaired by Ian Sutherland. Both CCC2002 and CCC2004 were held in Asia, respectively in Beijing, China, chaired by TianYou Zhang, and in Tokyo, Japan, chaired by Isao Oka. The 4th and 5th editions were held in America; North America for CCC2006 in Washington, Bethesda, USA, chaired by Yoichiro Ito and Guido Pauli, and South America for CCC2008 held in Rio de Janeiro, Brasil and chaired by Gilda Leitao.

Table 1 lists the countries of the 104 scientists who registered for CCC2010. There was a significant increase in attendance compared to CCC2008 (~75 attendants) but the record attendance (~150 participants) of CCC2006 was not reached. Nevertheless, the number of participants compared favorably with the average of the first

[1] Andrew Marston could not go on with the CCC2010 organization due to its 2009 move from Switzerland to University of the Free State, Bloemfontein, South Africa.

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Table 1
Registered international participation at the pre-conference CCC short course and the conference itself.

Country	Short course	Conference
France	3	24
UK		17
China		11
Brazil	1	10
USA	1	10
Russia		6
Japan		6
Germany		6
Spain		3
South Korea		3
Sierra Leone	1	2
Poland	1	1
Saudi Arabia		1
South Africa	1	1
Netherlands		1
Greece	1	1
Canada		1
Algeria	1	1
Austria		1
Total	10	104

The actual number of attendees was 99.

Fig. 1. Dr. Yoichiro Ito from NIH, Bethesda, USA, the founder of the technique; Dr. Walter Conway from University of Buffalo, New York, USA, a theoretician of the technique, and Dr. Alain Berthod from University of Lyon, France, CCC2010 chairman.

CCC conferences (CCC2000 – 100, CCC2002 – 65 and CCC2004 – 84 [2]). As always observed, the organizing country was the most represented in participant number.

CCC2010 received a record number of poster communications with 68 posters presented in the ISTIL building hall room. Forty

Fig. 2. Top: An attentive audience is listening to a talk given by Ian Garrard in the great ISTIL amphitheatre. Bottom: Technical show; left, François Couillard in front of the Armen hydrostatic column SCPC 100 and the automated Armen Spot liquid handling system. Bottom right, Josselin Dayde of Chromacim showing the Camag automated thin layer chromatography handling and developing system.

Fig. 3. Left: The bronze engraved plaque of the Crafty Chromatographer Award. Right: Dr. Leslie Boudesocque receives the Edward Chou Award from Chairman Alain Berthod.

Fig. 4. Top: The CCC2010 participants gathered on Place Bellecour (Lyon, France) under the Sun King. In the background at right, the Fourviere basilica is seen on top of a hill. Bottom: At the gala dinner, Guido Pauli announces the city voted for CCC2012: Hangzhou, China.

keynote lectures and oral communications were also given in the three days.

4. Program

The CCC2010 opened on Wednesday July 28, with a plenary lecture given by Ian Sutherland (Brunel University of West London, UK) entitled *Scalable Technology for the Extraction of Pharmaceutics: Transition from Academic Know-how to Industrial Reality*. The audience was captivated to discover the magnitude of the CCC capabilities in industry. Three other keynotes lectures were given on the first Symposium day: one by the chairman, another by the founder of the CCC technique: Yoishiro Ito (NIH, Bethesda, USA) and the third one by a CCC theoretician: Walter Conway (University of Buffalo, New York, USA) (Fig. 1).

The CCC2010 conference program was divided into 6 sessions, which included: (i) theory and method development; (ii) instrumentation; (iii) natural products and biological purifications; (iv) new and original uses of CCC; (v) modeling and (vi) closing session. Guy Harris (Dynamic Extraction, USA) presented a rapid solvent scouting system utilizing "on-demand" preparation of the most used quaternary alkane–ethyl acetate–methanol–water solvent system. Ian Garrard (Brunel University, UK) presented a liquid handling robot for rapid solvent system selection (Fig. 2). Leslie Boudesocque (Université de Reims, France) proposed an ingenious and versatile way for ionisable compound purification. Xueli Cao (Beijing Technology and Business University, China) described a new spiral tube column for CCC. Gregoire Audo (Armen Instruments, Vannes, France) described an elegant way to extract active compounds in marine sediments using a hydrostatic CCC column. Tian You Zhang (Beijing University, China) gave a keynote lecture on the exponential CCC development and applications in South China. Neil Sumner (Astra Zeneca, Macclesfield, UK) in the closing lecture described the importance of CCC in filling needs and requirements of pharmaceutical research.

During the conference, the members of the international CCC committee met to discuss the possible recipients for the two prizes, nomenclature delicate points, and location of the 7th International conference CCC2012. Three candidacies were presented: Hangzhou (China), Cape Town (South Africa) and Moscow (Russia). It was not possible to see a clear winner within the wishes of the international committee so it was decided to give some time to the three candidate cities so that they can present their project to all CCC2010 participants and a vote will have the final decision. Dalene De Beer (Agricultural Research Council, Pretoria, South Africa) presented the South African project; Qizhen Du (Hangzhou) presented the Chinese project and Tatiana Maryutina (Vernadski Institute, Moscow) presented the Russian project. The audience voted for the Chinese project with Qizhen Du and Yuanjiang Pan as chairmen of CCC2012 in Hangzhou, the Shanghai neighbor city in China.

5. Sponsors and exhibitors

The major sponsors of CCC2010 were the University of Lyon 1 and the French Association for Separation Sciences (AfSep, http://www.afsep.com/). The University of Lyon 1 provided free use of the ISTIL building and a financial sponsorship from its Scientific Committee along with the financial and administrative organization of the symposium. AfSep offered each participant a 2Gb jump drive containing all symposium documentation along with a beautiful and convenient backpack. The Laboratoire des Sciences Analytiques, UMR CNRS5180, the lab of the chairman, provided five English speaking post-docs and students that helped to give a smooth running of the symposium venue.

CCC2010 would not have been possible without the generous sponsorship of the French builder of hydrostatic CCC columns: Armen Instruments (Vannes, France) (Fig. 2). Other industrial sponsors included Elsevier (Amsterdam, Netherlands) that gave a copy of the CCC2008 special issue to each participant, Dynamic Extractions (Slough, UK), Tauto Biotech Ltd. (Shanghai, China), Kromaton-Rousselet-Robatel (Angers, France), Chromacim (Voreppe, France), CC Biotech LLC (Rockville, USA) and Phytolab GmbH (Vestenbergsgreuth, Germany). Three instrument companies brought equipment to show at the exhibition: Armen Instruments (France), Dynamic Extractions (UK), and Chromacim (France) (Fig. 2).

6. Prizes and social events

The announcement of the winners of the Edward Chou and the Crafty Chromatographer prizes took place on the last day, July 30, at the closing session. The winner of the senior prize (Edward Chou Award, Fig. 3) was Pr. Artak Kostanian, from the Kurnakov Institute of General and Inorganic Chemistry, Russian Academy of Sciences, Moscow, for his general theoretical contribution to CCC and his contribution "*Controlled-cycle pulsed liquid–liquid chromatography: a modified version of the Craig's machine*" with co-authors Andrei Voshkin and Nikolai Kodin. The winner of the junior prize (Crafty Chromatographer Award) was Dr. Leslie Boudesocque of the University of Reims, France, for her oral contribution "*A new versatile process for purification of ionisable compounds using centrifugal partition chromatography*", with co-author Jean-Marc Nuzillard and Jean-Hugues Renault. Both laureates received a metal plate engraved with the CCC2010 monogram by a local artist (Fig. 3).

After an evening tour of Lyon in open buses, the participants of CCC2010 gathered together at Place Bellecour downtown Lyon under the equestrian statue of the Sun King (Louis XIV who was in charge of the Kingdom of France for a record of 72 years, 1643–1715) (Fig. 4). This famous statue was used to advertise the symposium (Fig. 1). Then we all walked leisurely up to the Chateau-Perrache palace, a three star restaurant, to celebrate the success of the conference, enjoying a gastronomical dinner washed down with Alsace, Bourgogne and Bordeaux wines and listening to Guido Pauli (University of Chicago, USA) announcing the results of the CCC2012 vote with the preferred Hangzhou location (Fig. 4).

References

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