New Developments for the Automatic Control of Spirits Distillation

The aromatic composition of a fruit distillate not only depends on the raw material, but also on the distillation system and its operating conditions. The production of fruit distillates consists of several processes. For the final composition of the distillate the most important is the distillation process. In spirits distillation, Charentais stills operating in batch mode are most often used in small-scale production. During distillation three cuts are recovered (head, heart and tail) to obtain highly aromatic spirits with low levels of toxic components and off-flavors. Since the operation of this process is apparently simple, it is usually carried out manually. However, spirits distillation is subjected to many disturbances that generate variability in the composition of the final product. In addition, it is hard and time consuming to adapt the distillation recipe to the market demand for new products. Today consumers look for spirits which are safe and possess a distinctive aroma. Our research focuses on using modern engineering tools such as modeling, optimization and automatic control, to produce consistently spirits which are rich in specific aromas, and free from off-flavors and toxic compounds. The hypothesis that guides our work is that the aromatic characteristic of fruit spirits obtained in Charentais stills can be shaped by properly handling the addition of heat in the boiler. The method involves (i) development of a dynamic process model derived from mass and energy balances, (ii) application of various model based optimization techniques to establish a heat addition policy, (iii) development of automatic control systems able to follow closely a given heat addition policy, despite unmeasured disturbances, and finally (iv) experimental validation with artificial and real fruit wines. In this plenary lecture I will describe how we applied this methodology to reduce the methanol content in distillates obtained from artificial hydroalcoholic mixtures. In addition, I will discuss how we plan to apply this methodology to more challenging cases such as enhancing the floral and fruity characters of spirits obtained from artificial and real wines. The results of this project will allow to design distillation recipes for Charentais stills to produce any spirit with enhanced specific aromatic characteristic and with minimum levels of toxic compounds and aromatic defects.

Ricardo Pérez-Correa received the BSc and MSc degrees in Chemical Engineering in 1982 from the Faculty of Mathematics and Physical Sciences (FMPS) of the University of Chile (UCh). In 1987 he was awarded the Diploma of the Imperial College and a PhD degree from the University of London, both in Chemical Engineering. That year he joined the Chemical Engineering Department at FPMS of UCh as an Assistant Professor. In 1991, Prof. Pérez-Correa took an appointment as Assistant Professor at the Chemical and Bioprocess Engineering Department of the Catholic University of Chile. Then he was appointed Associate Professor in 2000 and Full Professor in 2011. Professor Pérez-Correa research interests include modelling, control and optimization of several chemical processes and bioprocess, such as spray and rotary drying, flotation, distillation, solvent extraction, solid substrate cultivation, submerged fermentations and production of natural products. He held visiting positions at Imperial College (1989) in London, Carnegie Mellon University (2001-2002) in Pittsburgh (USA) and Universitat Rovira i Virgili (2009) in Tarragona (Spain). Ricardo Pérez-Correa was recipient of the Jack Ewer grant from the British Council in 1989, the Fulbright grant from USA in 2001, the PIV grant from AGAUR of the Generalitat de Catalunya in 2009 and the Hutchison Medal from IChemE (UK) in 2015. He is a member of the Directory Board of the Chilean Association of Automatic Control (ACCA), IFAC Chilean section. Professor Pérez-Correa has published over 70 ISI papers and more than 30 book chapters. He has supervised 5 postdoc researchers, 6 PhD students and 19 MSc students.

Prof.-Dr. Ricardo Pérez Correa
Full Professor
Pontificia Universidad Católica de Chile
Department of Chemical Engineering and Bioprocess
E-mail: perez@ing.puc.cl
Telephone: +56-22-3544258