AIChE[SM] section Chicago Columns

Chicago Section
American Institute of Chemical Engineers
www.aiche-chicago.org

January Meeting Notice

Tuesday, January 9, 2001
Art Institute of Chicago
Intersection of Adams and Michigan Ave.
Downtown Chicago

The Berghoff
17 West Adams St
Chicago, IL 60603
(312) 427-3170
www.berghoff.com
(see map on next page)

Agenda

Tour the Art Institute:_____5:30-7:00pm
(meet the group at the entrance or feel free to tour on your own)
Walk to Berghoff Restaurant:____6:45-7:15pm
Cash Bar at Berghoff Restaurant:_6:30-7:30pm
Registration at Berghoff:_____7:00-7:30pm
Dinner:_____7:30-9:00pm

Entree Choices

- Cornish game hen marinated in cinnamon and nutmeg with spaztles
- Grilled vegetable platter with rice pilaf and roasted red pepper
- Both entrees include a dinner salad, creamed spinach, apple strudel, and coffee or tea.

Cost

$26_____for members

$28_____for non-members

Make your reservations by calling (847) 588-3840, online at www.aiche-chicago.org or e-mailing evalopez@teianalytical.com by Friday, January 5, 2001 before 12:00 noon.

Parking

55 E. Monroe Self-Park
Discount Berghoff parking after 4 PM for patrons with stamped ticket
(312) 986-6821

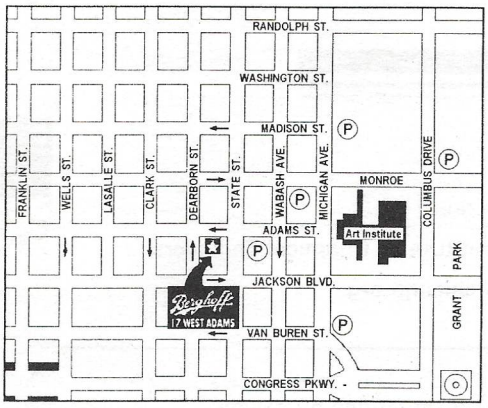
Grant Park South Parking Garage
Underground, self-park
325 S Michigan Ave
Enter from northbound Michigan Avenue at Congress Parkway.
(312) 747-2519

Social Night

Tour the Art Institute of Chicago

Back by popular demand, our social event this year will include an evening at the Art Institute of Chicago. Dinner will again follow at the Berghoff Restaurant, famous for its own special beer and outstanding cuisine. Some may remember touring the Impressionist gallery featuring paintings by Monet and Renoir for our social event a few years ago. One evening is not enough to see all the Art Institute has to offer. And if you haven't visited the Art Institute in awhile, come out for this event. As always the Art Institute is free on Tuesdays. Exhibit maps are available at the Institute's entrance.

After touring the Art Institute, walk three blocks west on Adams Street to the Berghoff Restaurant to enjoy their German cuisine.



Chairman's Corner

Suzette Wick, Dedert Corp.
Chair 2000-2001
Chicago Section AIChE

January is a time for New Year's resolutions. We reflect on the previous year, and look forward to improvements in the coming year. I personally accomplished my resolution for 2000 by learning to drive a car with a manual transmission. It may seem like a rather simple resolution to most of you, but I think that is the key to success. Keep it simple.

Reflecting back on 2000 with AIChE, it has been a time of planning. Many of our key events will take place in 2001. Our annual symposium on SMBs and Chromatographic separation is in the final planning stage, and we are gearing up for a Career Fair in September of 2001. In addition to these programs, we are working on our regular monthly meetings, making every effort to provide interesting speakers.

So, being inspired by one of my fellow volunteers with a keen sense of humor, I would like to offer my Top 5 (shortened for space) list of reasons to make participating in AIChE one of your resolutions for 2001. My apologies to David Letterman.

5. Plant tours - you get to see someone else's problems and accomplishments.
4. Visit a school - you may influence a child and get a free meal.
3. Attend a meeting - there are interesting people there (and good food) .
2. Check out the symposium - you can impress your coworkers by knowing what SMB stands for.
1. Chemical Engineering can be fun!

Company Sponsorship of AIChE Meetings

The committee's efforts at sponsorship of monthly meetings are off to a good start.

Our sponsors are:

September
RICH'S (Food Industry)

January
Project Resources Inc. (Process & Project Eng.)

February
Packer Engineering (General Engineering)

The committee requests you to energize your company to become a sponsor. The interaction between the engineering community and your company can be stimulating and rewarding for both. Please take a special initiative to make this program a success.

Once you have promoted your company's interest, any one of the following members will be happy to coordinate and develop the details with you.

N. Sankaran, UOP LLC
nsankara@uop.com
847-375-7893

Annette A. Johnston, Abbott Labs
Annette.Johnston@juno.com
847-433-7738

Rebecca J. Patrick, Cognis Corp.
Rebecca.patrick@cognis-us.com
815-939-6088

The Professional Engineers Exam

For those of you considering becoming a licensed Professional Engineer, the Chicago Section will be offering organized review sessions for the April Exam. The Professional Engineer (PE) exam is offered twice a year, in April and October. The registration deadline is about 6 months prior to the exam date.

Licensure requires a passing score on two exams, the Engineer in Training (EIT) and the PE exams. In Illinois, the first exam can be taken any time after you register with the Illinois Department of Professional Regulation, in Springfield, IL. The PE exam requires a minimum of 5 years of applicable engineering experience. Both exams are prepared and scored by the National Council of Examiners for Engineering and Surveying. The PE exam format has recently been changed to 80 multiple choice questions split between a morning and afternoon session. There are 40 questions in each session, with 4 hours to work the questions. The topics include questions from typical areas of chemical engineering practice. Some of the topics include mass transfer, heat transfer, kinetics, fluid dynamics, thermodynamics, and plant operations. The set of skills that are tested is updated periodically to reflect the work of chemical engineers.

Students See Chemical Engineers Are In Another World

by Alan Zagoria

Our section's Student Outreach Committee had another great day at Chemistry Day. This year's activities were held at Loyola University on November 4. We again attracted hundreds of students (mostly middle school and high school) to our booth with our display discussing "Chemical Engineering the Space Shuttle's Life Support System." Of course it was the flashing lights and free candy that really brought the students in, but it was the down-to-earth, informative discussions with our AIChE volunteers that really kept their attention. This different slant on the kind of problems engineers solve caught the imagination of even our youngest guests. Gloria Fountain, Don Nell, Debbie Quock, and I represented the Section. Thanks to our volunteers for a job well done!

Nominations Requested for the Ernest W. Thiele Award

The Ernest W. Thiele award is sponsored by BP Amoco and recognizes the outstanding contributions to our profession by a Midwest region chemical engineer. This award was established by the AIChE Chicago Section and is presented annually to a Midwest region AIChE member. This internationally recognized award consists of an engraved plaque and $1000 honorarium.

Nomination forms and additional information can be obtained from the Thiele Committee Chair: Completed nominations are due to the committee chair no later than March 30, 2001.

Jim Simnick
BP Amoco Complex, J-8
150 W. Warrenville Road
Naperville, IL 60566
Ph 630-420-5936
fax 630-420-4832
email: simnicjj@bp.com

Chicago Section Columns is published eight times a year by the Chicago Section AIChE. Opinions expressed herein are those of the authors and are not necessarily those of the officers of the Chicago Section. Copy for inclusion in the next Chicago Section Columns must be received no later than December 29, 2000.

The objectives of the AIChE are to advance chemical engineering in theory and practice, to maintain a high professional standard among its members and to serve society, particularly where chemical engineering can contribute to the public interest. If you have any questions or comments regarding the newsletter please contact Mark Kuehne, NL Chemical Technology, 479 Business Center Drive Suite 100, Mount Prospect, IL 60056; Phone 847-824-2888; Fax 847-824-2898; MarkKuehne@aol.com.

Nominees to the Honor Roll for Engineering Accomplishments

The 75th Anniversary of the Chicago Section was held on May 20, 2000. As part of the celebration, 75 people were nominated to the Honor Roll for Engineering Accomplishments by chemical engineers in the Chicago area. Throughout the year, we will be highlighting some of these individuals and their achievements in each issue of the Columns. Thanks again to everyone who helped make this event special.

John B. White, Sr.:

Education: M.S. Ch.E. Massachusetts Institute of Technology
B.S. Ch.E. Armour Technical College (IIT)

John White was one of the first two chemical engineers at UOP and is considered by them to be the "Father of Engineering" at UOP. One of his first projects there was to develop physical property and thermodynamic data to improve the scale up of processes from the pilot plant. Out of his work came the K characterization factor, which is still used today to characterize petroleum mixtures. He also developed numerous charts that later became the UOP Process Design Manual.

His years in the application of chemical engineering principles have brought about many significant contributions including work on Cat. Poly and Isomerization plants that contributed to the WWII efforts in producing aviation fuels. He also was part of the team that developed the UOP FCC and Alkylation unit designs, and the Udex process that revolutionized the petrochemical industry.

G. Ali Mansoori:

Education: Ph.D. University of Oklahoma
M.S. University of Minnesota
B.S. University of Tehran

Ali Mansoori has made a significant impact on the area of computational theories for thermodynamics and industrial practice. The thrust of his research for nearly 30 years has been in the area of applied statistical mechanics of liquids, solutions, phase transitions, and interfacial phenomena. His findings have been applied to the characterization and processing of natural gas, supercritical fluids, petroleum fluids and the retrograde phenomena. The chemical and petroleum industry uses the equation of state, mixture theories and mixing rules, supercritical fluid solubility models, petroleum fluid characterization, and heavy organic deposition models developed by Mansoori. Further, he is a fellow of AIChE and is active at both the local and national level.

Don Carson:

Education: M.S. University of Michigan
B.S. University of Michigan

Don Carson was the Director of Engineering at UOP for many years. He led the development of the Sorbex technology including the design of the core rotary valve technology. Carson is also credited with having patented the basic concept of the CCR Platforming process. He amassed over 60 patents in his career and received the "Inventor of the Year" award from the Patent Law Association of Chicago. In addition to his efforts at UOP for over 40 years, Carson was a fellow in AIChE.

Darsh T. Wasan:

Education: Ph.D. University of California at Berkeley
B.S. University of Illinois

Darsh Wasan has been active in chemical engineering in Chicago for over 30 years. Many groups have recognized him for his outstanding contributions to chemical engineering education through excellence in teaching, scholarship, academic administration, and service to professional and educational societies. Wasan is a fellow of AIChE and received the Thiele award in 1989 for his contributions as an aspiring teacher and a dynamic leader. In his research, he was a pioneer in advancing the frontiers of colloid science and interfacial phenomena. One of his most significant contributions is the development of a novel instrument for interfacial rheological measurements and thin liquid film measurements. Additionally, he is credited with over 300 journal publications, 2 books, 6 research monographs, 18 book chapters, and 4 U.S. patents.

Chromatography Symposium March 14

Plan to attend the AIChE Chicago Section Symposium on March 14 at Pharmacia (Searle) in downtown Skokie. The day will begin with an induction to classical batch chromatography and simulated moving bed chromatography. After presentation of some applications, design parameters and issues will be discussed. The day will conclude with our March local section meeting, which is a tour of the pilot plant and separation lab facilities at the Pharmacia site.

In this newsletter, a paper describing chiral separations with simulated moving bed chromatography has been included. This particular application is most used by pharmaceutical companies. Non-pharmaceutical applications will also be presented. Read the paper to get an idea of what will be presented at the symposium.

A brochure listing the tentative program for the symposium has also been included in this newsletter. Use the registration form in the brochure to register now. Mark your calendars!

Wanted: Engineer Mentors & Judges

The Chicagoland Engineers Week Committee is once again sponsoring the 2001 Future City Competition being held in at least eighteen cities nationwide. This annual competition is held for 7th and 8th grade students to foster interest in engineering, math and science through hands-on computer modeling, essay writing, oral presentation and model building of the students' "Cities of the Future." Schools from Chicago and the suburbs annually participate in this event.

VOLUNTEERS are needed to help plan the competition, be an engineer mentor to a school or be a judge for the competition in January. Planners are needed to work with the schools, help sign up volunteers and help with mailings and press releases. Engineer mentors will work with the students in an advisory role. They will visit their school 4-8 times throughout the competition, answer questions and guide the students. Judges are needed for two Saturdays in January to score the students' work. Information sessions will be held to assist the engineer mentors and judges in their responsibilities and to answer questions.

Please call Don Wittmer at (312) 930-9119 or e-mail him at dwittmer@hntb.com to sign up or to get more information.

Why Would I Want To Be Licensed? Part I

by Jonathan M. Diller, P.E.

My employer doesn't require it for promotions. I have never or rarely needed to have a document sealed by a licensed engineer. Why would I want to be licensed?

This is the first in a five part series on professional licensure and the chemical engineer. The tentative article list is as follows:

- Why Would I Want to Be Licensed? Part I
- Requirements for Professional Licensure
- Why Would I Want to Be Licensed? Part II
- Answers to Licensure Questions
- The Process of Applying for Licensure

If we receive significant feedback, we can modify the articles to address specific items of interest.

The following are three important reasons to begin taking steps to be licensed now.

- You never know what the future holds.
- The rules change - often!
- It may be more valuable than you believe.

How many people do you know that have had to make sudden career changes? Layoffs, family circumstances, and other unforeseen events can create an immediate need to change employment and possibly career tracks. Licensure keeps your options open to work as independent consultant, for a consulting firm or for an employer that sees value in licensure.

The rules for licensure frequently change and, almost without exception, each change makes it more difficult, time consuming and/or expensive to become licensed.

The benefits of licensure may be unseen to you. If your firm is involved in litigation and needs an "expert" witness, the courts will look more highly upon a witness that is licensed, or may possibly even require it.

Many submittals to regulatory bodies require documents to be signed or sealed by a licensed engineer. You have not been asked because they know you are not licensed.

Your next employer (whether with a different company or not) may be looking for, or attracted by, the added flexibility that licensure gives you. They may desire someone to manage submittals that need that seal that the governmental review agencies require. Or they may simply see it as a strong statement of your self-motivated commitment to professional development.

I strongly recommend that all professional engineers become licensed as soon as they become eligible. The exam process is not that difficult (as opposed to the application process). There is a great sense of personal achievement in receiving your license. In addition, there is the knowledge that you have the key to open doors that you may want or need to enter in the future.

Please contact me if you have any questions or comments about licensure. Written questions will be responded to in person, and questions of a general nature may be included in a future article.

Mr. Diller is a Senior Engineer with Robinson Engineering, Ltd. in South Holland, Illinois. He holds a BSChE from Rose-Hulman Institute of Technology and has been licensed in four states. He can be reached by telephone at 708-585-5467 or by e-mail at jdiller@reltd.com.

Jobs Bulletin - January 2001

Position Seekers

S-0011 Environmental Manager Masters in Environmental Engineering with 2 years experience seeking position in Houston area. Desires chemical industry. Telephone (521) 224-4919

Positions Available

A-0027 Test Equipment Engineer Search firm seeking candidates with AS or BS technical degree with 3-5 years experience for glass manufacturer in Pennsylvania. Candidates must be computer literate, familiar with laboratory test procedures and capable to establish measurement techniques. Will direct and oversee laser glass product quality testing and measurement operations. Position requires working rotating shifts. Contact Forest Finding @(801) 741-8536

A-0028 Glass Fabrication Specialist Search firm is seeking specialist with 3-5 years experience for manufacturer in Pennsylvania. Background must include experience in optical glass fabrication including knowledge of associated machinery and equipment such as Blanchard grinders, saws, rotary surface grinders etc. Hands on experience is preferred. Prior optician, optical technician or engineering experience with glass processing equipment producing precision optical finishes is required. The specialist will provide leadership role and will train personnel to operate precision glass cutting equipment etc. Contact Forest Finding @(801) 741-8536

A-0029 Manufacturing Engineer Search firm seeking BS or MS with 3-5 years industrial process experience for glass manufacturer in Pennsylvania. Person must be willing to assume future production management role in new glass manufacturing facility expansion. Role in finalizing process design, selection and installation of production equipment. Contact Forest Finding @(801) 741-8536

A-0030 Glass Composition & Melting Engineer Search firm seeking BS or MS Chemistry, Chemical or Ceramic Engineering with 3+ years experience for manufacturer in Pennsylvania. Prior technical glass melting experience preferred. Individual should possess excellent analytical skills, the ability to interact and communicate effectively at all levels. Must be willing to assume a leadership role. Work involves compositional adjustments, control of melting parameters, new product development involving a variety of continuous and non-continuous melting technologies. Contact Forest Finding @(801) 741-8536

A-0031 Human Resources Manager Search firm seeks a degreed HR manager with 4-10 years experience for glass manufacturer in Pennsylvania. Must be familiar with regulations used within manufacturing facility. Will manage personnel, training, and regulatory aspects of position. Contact Forest Finding @(801) 741-8536

A-0032 Production Supervisor Search firm seeks BS engineer with 3-8 years experience in manufacturing. For manufacturer in with multi locations. Glass experience an asset. Good communication skills. Will supervise production . Must be a decision maker and able to suggest improvements. Contact Forest Finding @(801) 741-8536

A-0033 Engineers Small, dynamic company in the field of environmental and energy technology R&D seeking chemical or mechanical engineers with 4-7 years experience with BS, preferably MS. Position located in Chicago suburbs. Hands-on design and experimental work preferred. Chance to get in on ground floor. Contact Dan Lyons @ (630) 852-0104 or email at danlyons12@aol.com

Dated Mail

Chicago Columns
section

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Niles, IL 60714

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SIMULATED MOVING BED (S.M.B.): PRINCIPLE AND APPLICATION TO CHIRAL SEPARATIONS

Jean BLEHAUT, Wilhelm HAUCK – NOVA*SEP* Inc., 23 Creek Circle, Boothwyn, PA 061
R.-M. NICOUD - NOVA*SEP*, B.P. 50, F-54502 Vandoeuvre-les-Nancy, France

ABSTRACT

The Simulated Moving Bed (S.M.B.) chromatographic process is presented as an attractive process for small or large scale separations of optical isomers. In opposite to the classical batch chromatography, S.M.B., thanks to an astute connection between columns allows to perform continuous separations. Moreover, as S.M.B. is based on a counter-current contact between the fluid and the stationary phase, it allows to maximize productivity and to minimize the eluent consumption. After its first introduction at the beginning of the 90's, a very significant number of results have been obtained and published related to the obtention of optically pure enantiomers, several industial scale production SMBs have been implemented since 1997, and more are to come. New developments include the integration of the chromatographic step in a global process, aimed at optimizing yield and productivity.

BASIC PRINCIPLES

In opposition to the "usual" (elution) chromatography, SMB is a continuous process and is thus much more adapted to large-scale production. Moreover, SMB being based on a counter-current contact between the liquid and the adsorbent generally leads to much lower eluent consumption, which is a second key advantage.

The easiest way to understand the SMB concept is to consider a True Moving Bed (T.M.B.) as described in figure 1, in which a counter-current contact is promoted between the solid and the liquid phases. The solid phase goes down in the column thanks to gravity; when it exits the system (zone I), it does not contain adsorbed products and is thus recycled at the top of the system (Zone IV). The liquid (eluent) stream follows exactly the opposite direction: it goes up and is recycled from zone IV to zone I. Feed, containing components A and B is injected at the middle of the column, and the fresh eluent at the bottom.

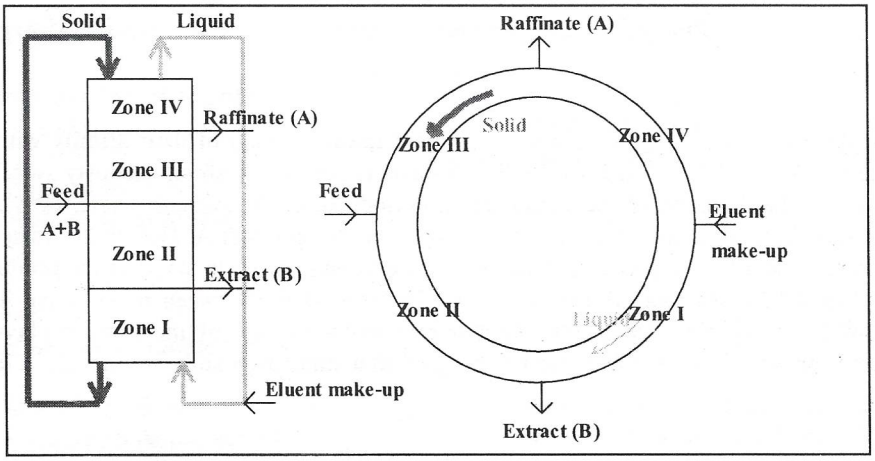

Figure 1
True Moving Bed: two equivalent representations.

Provided that the affinity of A and B for the solid are different (B is more retained than A in figure 1), it is possible to choose flow rates in order to let A move upward and B move downward, thus leading to a spatial separation. This system requires two inlet lines (one for the feed and one for the eluent) and two outlet lines (one for the raffinate A and one for the extract B).

The classical moving bed is made of four different zones[1], in which different constraints must be fulfilled:
Zone I (between the eluent make-up and the extract points): the more retained product (B) must be completely desorbed (B moves up in zone I).

Zone II (between the extract and the feed points): the less retained product (A) must be completely desorbed. (A moves up in zone II).

Zone III (between the feed and the raffinate points): the more retained product (B) must be completely adsorbed. (B moves down in zone III).

Zone IV (between the raffinate and the eluent make-up points): the less retained product (A) must be completely adsorbed. (A moves down in zone IV).

All the internal flowrates are related to the inlet/outlet flowrates by simple mass balances:

$$Q_{II} = Q_I - Q_{Ext} \qquad Q_{III} = Q_{II} + Q_{Feed}$$
$$Q_{IV} = Q_{III} - Q_{Raff} \qquad Q_I = Q_{IV} + Q_{El} \tag{1}$$

And the inlet/outlet flowrates are related by:

$$Q_{Ext} + Q_{Raff} = Q_{Feed} + Q_{El} \tag{2}$$

In fact, it is extremely difficult to operate a TMB because it involves circulation of a solid adsorbent ; the interesting TMB concept must be implemented in a different way. It can be shown, that most of the benefit of a true counter-current operation can be achieved by using several fixed-bed columns in series and an appropriate shift of the injection and collection points between the columns: this is the SMB implementation as presented on figure 2.

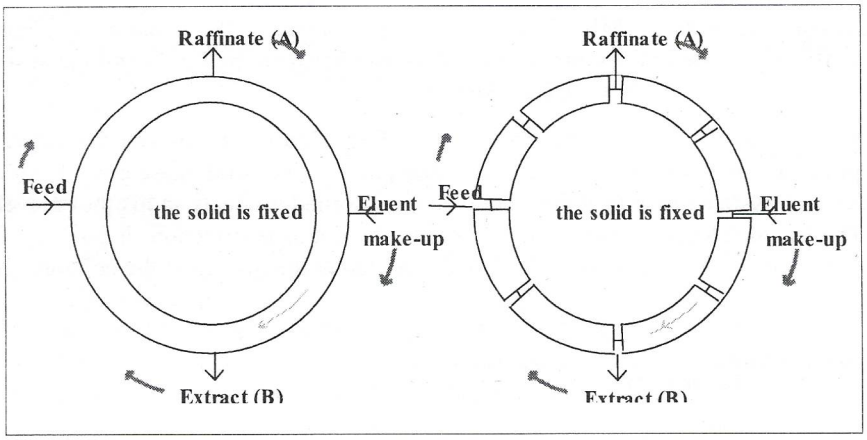

Figure 2 - Principle of the Simulated Moving Bed
Left: concept (inlet/outlet lines are shifted continuously),
Right: implementation (inlet/outlet lines are shifted step by step),

In a SMB, both A and B move clockwise, "pushed" by the liquid at different rates, function of their affinity with the solid. The simulated solid flow rate counter-clockwise (against the liquid flow) is created by simultaneously switching the inlet and outlet points clockwise (in the direction of the liquid flow), periodically. The switching rate, or period, allows the inlet and outlet lines to move faster than the product B and slower than the product A. Beside the switching rate, the key of SMB is to properly select the different flow rates: they must be chosen in order to stabilize the product B between zones I and III and the product A between zones II and IV, and to allow separation between zones II and III, as in a TMB. The adequate choice of the SMB flow rates requires a minimum knowledge of the physico-chemical properties of the system (adsorption isotherms, plate number, etc.) to be used in a simulation software, or ..... a lot of patience.

TECHNICAL ASPECTS

Our experience led us to advise a system using a recycling pump which is fixed with respect to the columns (reliability, minimum number of valves), to use pumps instead of valves to deliver the flow rates, and to counter balance the effect of the recycling pump thanks to the use of an asynchronous shift of the inlet/outlet lines. A simplified flow sheet of a 12 columns unit built according to this concept is given on figure 3.

[1] warning: the zones definition varies according to the authors

At the inlet of each column, 4 valves (F, E, Ex, R) allow the connection to Feed, Eluent, Extract, or raffinate pumps.

The technical conception of a SMB is not easy as this technology requires a strong precision for all the flow rates (usually better than 1 %), and for instance, great care must be taken to all the connections between the different lines in order to minimize dead volumes. Moreover, all the columns are to be nearly identical, and very stable. This is achieved using the Dynamic Axial Compression principle.

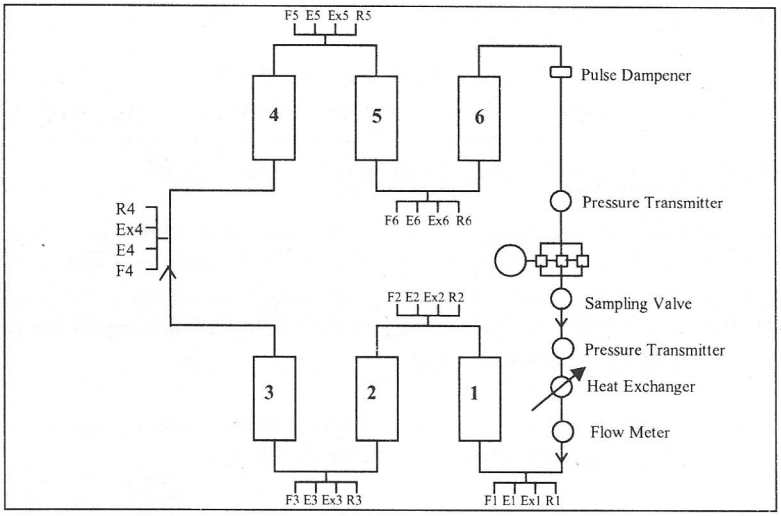

Figure 3: Possible Flow sheet of a 6-column SMB

OPERATING CONDITIONS

The steps to be followed when designing a SMB which would allow to process a given amount of feed per month have been described in detail [Charton and Nicoud, 1995]. The procedure is based on the modeling of non-linear chromatography. Unless the adsorption isotherms are linear (which is very uncommon in fact or valid only at very low concentrations), the determination of SMB operating flow rates requires the use of a simulation software, which allows to obtain pure products from scratch in a week time (provided that the required eluent and stationary phase are available).

The procedure is typically fast and simple. It consists of the following steps:

- Optimization of the separation conditions (eluent and stationary phase), using a typical analytical HPLC column and a standard HPLC system;
- Determination of the number of plates in the best separation conditions obtained;
- Injection of increasing amounts in the analytical HPLC column, in standard conditions (temperature, eluent, flow rate), until the "touching band" chromatogram is obtained;
- Determination of the pressure drop generated in the column in standard conditions;
- Entry of the previously generated data (together with the characteristics of the SMB system to be used) in the simulation software.

The simulation software automatically determines all necessary operating data and process information:

- All SMB flow rates and switching time
- Purity
- Yield
- Productivity

In general, this method leads to good purity and yield for the first or second set of flow rates actually applied to the SMB.

The SMB can easily be scaled up, now from 1-cm i.d. columns to 100-cm i.d. columns (1:10000 factor).

CONCLUSION

SMB chromatography has been used more and more widely for large-scale separations of optical isomers, due to the development of both efficient chiral stationary phases and modeling software. Compared to preparative HPLC, the use of SMB drastically reduces the cost of chiral separations, mainly by reducing chiral stationary phase needs (generally 2-5 times lower), and the eluent consumption (up to 10 times more favorable). Production scales of 10-100 tons per year with separation costs as low as US$ 30 to $100 per kg of pure enantiomer are now reached [Nicoud, 1999].

Several pharmaceutical companies and large-scale toll manufacturers have adopted SMB for large-scale chiral separations of pharmaceutical active ingredients or intermediates. Such companies include [Mc Coy, 2000]: UCB, Bayer, H. Lundbeck, Honeywell, Daicel, Aerojet Fine Chemicals to name a few. The largest unit in operation for a chiral separation has six, 80-cm i.d. columns and a SMB with 100-cm i.d. columns will be operational in 2001.

New trends in large-scale chiral separation processes are the coupling of SMB with other techniques, such as racemization and/or enantio-selective crystallization. On-line racemization of the non desired enantiomer allows one to strongly reduce the racemate consumption, while downstream enantio-selective crystallization allows one to decrease the purity of the desired product obtained by SMB [Blehaut, 1998], the consequence of both being an increase of the whole process productivity. The use of powerful simulation software is essential to optimize such processes.

Also, SMB is now used as a powerful tool to purify complex mixtures. For instance, purifications of peptides from complex fermentation broths or solid phase syntheses have been described or are being developed.

More recently, the VARICOL ® [Ludemann-Hombourger, 2000], a new multi-column chromatography process, was introduced. Its originality resides in using zones of variable lengths, by switching inlet and outlet valves in an astute way. Compared to SMB, this new process is not any more a true counter-current process, but allows one to reduce the eluent consumption and/or to increase the productivity.

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1. Charton F., Nicoud R.M., Journal of Chromatography A., 702, pp. 97-112, 1995
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5. Ludemann-Hombourger O. et al., Separation Science & Technology, 35 (12), pp. 1829-1862, 2000

Make Plans to Attend the All-Day Seminar on

Discussion of Batch and Simulated Moving Bed Design and Applications
AIChE Chromatography Symposium 2001
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- Design, installation and the economics of industrial batch and SMB units

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Program Summary

7:30—8:30am	Continental Breakfast and Registration
8:30—10 :00am	Plenary Session: Basics of Chromatography, SMB
10:30am-12:00pm	Example Applications
	Breakout Session I: Pharmaceutical Applications
	Breakout Session II: Non-Pharmaceutical Applications
12:00—1:00pm	Lunch and Vendor Show
1:30—2:30pm	Plenary Session: Parameters and Design Details
3:00-4:30pm	Breakout Session III: Modeling Chromatography Processes
	Breakout Session IV: Design of Chromatography Processes
4:30-5:30pm	Plenary Session: Engineering Issues and a look to the Future
5:30—7:30pm	Pharmacia Tours and Buffet
7:30pm	Pharmacia Speaker

Featured Speakers

- Dr. Linda Wang, Purdue University
- Dr. Ali Mansoori, University of Illinois at Chicago
- Lou Bellafiore
- Larry Miller, Chromatography Group, Pharmacia
- Jeff Elst, Fermentation Recover, Abbott Laboratories
- Novasep, Inc