PROCESS INTENSIFICATION NETWORK NEWSLETTER

PIN NEWS

The Newsletter of the Process Intensification Network

Issue 6 *March 2002.*

Editorial

PIN has come to the crossroads in respect to its continued existence now that our original EPSRC funding has expired. At our last meeting in Cambridge some attendees suggested that industrial organisations would be prepared to contribute £1000-£3000 depending on their size for the next year's operation. So far we have firm promises of £15000 towards an annual cost of £19000. Much of the shortfall could be made up by charging additionally say £100/per person per meeting, provided we maintain our attendance record of at least 40 paying attendees. Our original plan to secure full funding for 3 years from Government (e.g. Health & Safety Executive, Future Energy Solutions, DTI) is looking increasingly optimistic so we may be forced to operate on a hand-to-mouth basis. Your views on whether a £100 meeting fee would be a significant deterrent would be welcome.

Meanwhile, some good news! The EPSRC refurbishment of our laboratory facilities at Newcastle is virtually complete and we have 10 ventilated and fully serviced enclosures which are available for pilot scale industrial demonstration projects involving intensification technology. Hopefully this will address the thorny problem of convincing sceptical industrial colleagues of the virtues of radically improved, though potentially risky new technology. Perhaps this will break the logjam represented by "the rush to be second" philosophy!

Professor Colin Ramshaw
1 March 2002.

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PROCESS INTENSIFICATION NETWORK NEWSLETTER

PIN CONTACT POINTS

- **For membership information, offers of articles for *PIN News*, finding collaborators, and news of meetings, contact: *David Reay, PIN Co-ordinator, PO Box 25, Whitley Bay, Tyne & Wear, NE26 1QT, UK. Tel: 0191 251 2985; fax: 0191 252 2229; Email:*** DAReay@aol.com
- **For news, past meeting reports, profiles of members, links with other networks etc., contact: *PIN Website: http://www.ncl.ac.uk/pin/***

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'GUIDE TO PI' - UPDATE

Due to circumstances 'beyond our control', there has been a further delay in sending the PI Guide out to consultation. Two additional Chapters were requested (as reported at the Cambridge PI Meeting), these being on Drying/Crystallisation and Mixing. These are now completed and have been sent to HSE for editing and for submission to the sponsors.

The contents have been again reorganised, as follows:

Aims & Scope of the Guide

List of Figures & Tables

CHAPTER 1 INTRODUCTION

CHAPTER 2 PROCESS INTENSIFICATION – PROS & CONS

CHAPTER 3 TYPES OF INTENSIFIED PROCESSES – BASIC MECHANISMS INVOLVED

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CHAPTER 13 WHAT DO I DO NEXT?

Extensive Appendices will list equipment suppliers, R&D organisations etc.

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Boeing plans fuel cell to power fight test-bed

Boeing plans to test fly an electrically powered demonstrator aircraft in early 2004 as part of the manufacturer's work on finding environmentally friendly fuel cell technology for future aircraft. The programme will be one of the first involving the manufacturer's new research and technology centre in Madrid, Spain.

The project, which involves NASA, a number of European universities including the Technical University of Munich, fuel cell manufacturers and the automotive industry, will include adapting a single-engined aircraft by replacing its engine with fuel cells and an electric motor turning a conventional propeller.

The ultimate aim of the project is to replace an aircraft's gas turbine auxiliary power unit with fuel cells – a device that produces electricity through an electro-chemical process. Fuel cells are cleaner, quieter, have fewer moving parts and can generate more than twice as much electricity with the same amount of fuel than auxiliary power units.

Initially, Boeing aims to "learn more about fuel cells by powering a small aircraft and, as the technology matures, use fuel cells to power an aircraft electrical system, such as the in-flight entertainment system", says Dave Daggett, associate technical fellow, environmental performance strategy group.

The manufacturer is looking at various fuel options, with the most obvious being liquid hydrogen, says Herbert Lust, Boeing's policy director, environment. Although liquid hydrogen has weight issues, Lust says that fuel cells are becoming lighter as the technology matures. The electrically powered aircraft has practical applications which allows early implementation, says Lust.

Boeing Madrid, due to open in January, will design and integrate the experimental aircraft's control system. Madrid will be home to a number of environment-related advanced technology projects, says Boeing, declined to elaborate. Boeing Madrid is one of a number of research and development centres that the manufacturer is planning to establish. It already has a design centre in Moscow.

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EU Project Profiles:

A search of the EU web site reveals several PI-related projects, including the following:

Inherently Safer approaches to the Design of chemical process plant

This project, summarised below, has recently been completed under the EU Environmental Programme. Project reference is EV5V0416. Data can be found on the Cordis web site – http://dbs.cordis.lu/cordis-cgi/

Objective: To develop with industry the tools and information that can persuade and facilitate the integration of inherently safer approaches into plant design.

General Information: The concept of inherently safer chemical ***process*** plant has been around for many years. It encompasses the ideas of ***intensification***, substitution, attenuation and simplification. These ideas focus on hazard elimination and prevention and other benefits in terms of better operability and reduced lifetime costs as well as enhanced safety and environmental performance. In short, an inherently safer approach may offer a more effective, robust and efficient means to achieve tolerable levels of safety and environmental performance in today's business environment.

The project aims to achieve this by:

- Reviewing the current state of design approaches;
- Developing the means to address inherently safer issues in the design ***process***;
- Demonstrating the effectiveness of these means and the resulting benefits in terms of safety, costs and operability by carrying out a series of trials in industry on actual projects;
- Producing a series of reports and a symposium/workshop to pass on the lessons from the project and give industry the tools and information it needs to start to adopt inherently safer approaches to design.

Start Date: 1994-08-01

End Date: 1997-07-31

Another project under the INTAS (co-operation with Eastern Europe) programme was led by Aston University and involved Spain, Ukraine, Kazakhstan and the Russian Academy of Sciences:

Title: Development of physio-chemical and hydrodynamic ways of heat and mass transfer ***intensification*** under the influence of self organisation in two phase systems

General Information: This research will be oriented towards investigation into the physico-chemical hydrodynamics of a mobile interface to identify the relationships between physico-chemical properties and/or flow rates which produce enhanced phenomena of self organisation of such increased rates of transfer. This could be seen as a means of reducing size of equipment used in chemical plants for separation and reaction by countercurrent contact of gas/liquid or immiscible liquid/liquid.

The work will be done by achieving ***process intensification*** without the use of added energy by: development of ways to predict the self organisation and ***intensification*** of heat and mass transfer at the interface under Marangoni's instability and related effects of heat absorption and direction of surfactant flux; understanding the hydrodynamics and mass transfer under conditions of phase inversion, and the development of a new method of stabilisation and control of gas liquid flow to achieve self-stabilisation in packed or tray columns.

Start Date: 1995-07-01

End Date: 1997-06-30

The EU GROWTH programme project led by Thomas Swan & Co Ltd. with NWA Analytische Messgerate GmbH is of interest following the talk at the Heriot-Watt PIN meeting on supercritical processes:

Title: Continuous clean production of fine chemicals in supercritical carbon dioxide

Objective: Supercritical CO2 is an attractive medium for the cleaner synthesis of fine chemicals, offering the possibility of ***process intensification***, increased selectivity and reduced environmental impact. Recent research has demonstrated that continuous supercritical reactors can have distinct advantages for hydrogenation and other reactions. However, there is relatively little fundamental understanding of why these reactors are so effective. The project will therefore undertake investigations of phase behaviour, measurement of reaction kinetics and modelling at laboratory scale, and then proceed to develop scale up rules for industrial reactors. The Friedel-Crafts reaction will serve as a first demonstration of the know-how gained, but a wider range of reactions will also be studied, including etherification and de-hydrogenation. The prime proposer is Thomas Swan & Co, a UK SME: chemicals manufacturer with an interest in exploiting supercritical fluids as reaction solvents.

Start Date: 2000-07-06

End Date: 2001-07-05

A somewhat older project led by Aston University (Prof. Ken Porter), and with three organisations from the former USSR unde the INTAS programme should be available under project ref. INTAS-94-4674.

Title: Development of physio-chemical and hydrodynamic ways of heat and mass transfer ***intensification*** under the influence of self organisation in two phase systems

General Information: This research will be oriented towards investigation into the physico-chemical hydrodynamics of a mobile interface to identify the relationships between physico-chemical properties and/or flow rates which produce enhanced phenomena of self organisation of such increased rates of transfer. This could be seen as a means of reducing size of equipment used in chemical plants for separation and reaction by countercurrent contact of gas/liquid or immiscible liquid/liquid.

The work will be done by achieving ***process intensification*** without the use of added energy by: development of ways to predict the self organisation and ***intensification*** of heat and mass transfer at the interface under Marangoni's instability and related effects of heat absorption and direction of surfactant flux; understanding the hydrodynamics and mass transfer under conditions of phase inversion, and the development of a new method of stabilisation and control of gas liquid flow to achieve self-stabilisation in packed or tray columns.

Start Date: 1995-07-01

End Date: 1997-06-30

Study for the Development of Multi-Stage PI Plant

*A **UK led initiative to develop a technology route map for agile, customer-orientated process systems, which are inherently safe and environmentally friendly.***

Background

A PI Plant for multi-stage process, which integrates process intensification technologies with process simulation tools, on-line measurement and control for process optimisation is proposed. However, the feasibility of combining state-of-the-art developments and the integration of, the underpinning technologies needs to be carried out. BHR in collaboration with LGC (Laboratory of the Government Chemist) and ISC (Industrial Systems and Control), and with support from ETSU (now Future Energy Solutions), is conducting a survey and review to understand the issues.

Objective
The work aims to determine the need and route for launching a major UK initiative for multi-stage PI processes. The study will develop a route map which will identify and prioritise the need for research and development.

Concept
The development of methods for the design, specification and operation of PI-based Plant and their subsequent inclusion in; process modelling tools; intelligent measurement and; control of chemical processes

The concept of a PI Plant is shown schematically (in the leaflet produced by BHR Group) as a two stage reaction. The process, which is all in-line, shows reactants A and B being combined in the 1st stage reactor to yield product C which is then mixed in the 2nd stage reactor with reactant D to yield the final product E. These reactions can be fast (<1 minute typically) and highly exothermic. To ensure maximum productivity the quality of the reaction mass at intermediate and final stages will need to be measured so that operating conditions can be adjusted.

This is a complex measurement and control problem, as it demands continuous measurement and optimisation of the process. It will require the measurements to be rapid (instruments to have a fast response), yet accurate (to ensure product quality) and robust (to suit the process environment). A range of measurement techniques is needed to cover different reactions and reactants. Control must be fast and predictive to allow adjustments within the reactor residence time and is further complicated by having to operate in a dynamic environment.

The feasibility study will identify the barriers to the development and commercialisation of a multi-stage PI plant, and propose ways to mitigate against them. The research strategy delivered by the work should form the first step in developing a larger research proposal.

For more information: Gerry McNulty at BHRSolutions. Tel: +44 (0)1234 750422. Email: fluid@bhrgroup.com

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BHR Group Brugge 2001 PI Conference Proceedings Available

The proceedings of the 4th International Conference on Process Intensification, BETTER PROCESSES FOR BETTER PRODUCTS, held in Brugge, Belgium in September 2001 are available from:

Mrs Marian Rolfe, Publication Sales, BHR Group Limited, The Fluid Engineering Centre, Cranfield, Beds MK43 0AJ, UK. Telephone +44 1234 750422, Fax: +44 1234 750074, Email: **mrolfe@bhrgroup.com** . Price £125.00.

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For information on support for projects in the areas of heat transfer, compact heat exchangers, and intensified processes, contact:

Dr. Fiona Porter, Tel: 01235 433012; Fax: 01235 433727. Email: Fiona.Porter@aeat.co.uk

Note: ETSU, where Fiona works, has been renamed **Future Energy Solutions**. It remains part of AEA Technology and continues its strong involvement in the Government's Energy Efficiency Best Practice Programme.

A Funding Opportunity - Update

The third call for proposals on Low Carbon Technologies (see earlier issues of *PIN News*) has passed, with a number of submissions relating to PI currently being progressed.

PIN members will be among the first to know about any future calls, and members of the PIN Committee are able to advise potential proposers on the preparation of preliminary proposals and to give advice on the subjects that might be of relevance to the programme.

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Manufacturing Molecules Initiative (MMI)

At the Cambridge PIN meeting, Richard Bahu introduced us to the MMI initiative. Brief data and contact points are given below. The impression given at PIN was that it could be of considerable interest to members.

Over **£3 million** of Government funding is available for a wide variety of activities: LINK projects, general and specialist training, technology transfer, demonstrator and pilot projects.

For more information and an application form see our comprehensive website or contact the Chemicals Directorate:

Sue Bailey: 020 7215 1661 sue.bailey@dti.gsi.gov.uk
Helen Holmes: 020 7215 1130 helen.holmes@dti.gsi.gov.uk

Or visit:
Department of Trade and Industry www.dti.gov.uk/mmi

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On The Web: Spinning Tube-in-a-Tube!

Ming Tham, who runs our web site, came across the following web address recently:

www.rccostello.com/STT.html

It is worth exploring, as it contains information, diagrams and theory concerning a spinning tube-in-a-tube reactor from a US laboratory – an alternative to other rotating reactor concepts??

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Process Innovation and Process Intensification $(PI)^2$ Conference

September 9 – 13, 2002
Edinburgh, Scotland, UK

Final arrangements are now being made for the $(PI)^2$ conference in Edinburgh later this year. A full programme of papers is promised, and further data are given below.

PIN members are encouraged to participate.

The United Engineering Foundation (UEF) announces the first conference in Process Innovation and Process Intensification $(PI)^2$. It is evident that Process Innovation and Process Intensification

are a route to improved refining, chemical and biochemical processes. Government regulation and economic survival dictate that tomorrow's processes consume less energy and raw materials, treat less waste, cost less to build and operate, and provide lower risk to safety and the environment. This conference thus provides an extended forum for PI2 researchers world-wide to present their recent discoveries, developments and challenges in chemical, biochemical, biomedical engineering and related disciplines.

The conference will focus on the following areas:(a)novel material formulation/processing, (b) intensified reactors/mixers, (c) innovative separation techniques, and (d) new measuring and modelling/simulation techniques.

The Chairs of the Conference are Professor Xiong-Wei Ni, of the Department of Mechanical and Chemical Engineering, Heriot-Watt University, Edinburgh, Scotland, and David Trent of The Dow Chemical Company, Freeport, Texas.

Additional information about this Conference - and a registration form - can be found at the Conference's web site: http://www.engfnd.org/2ap.html.

The United Engineering Foundation is located at Three Park Avenue, 27th Floor, New York, NY 10016-5902; Tel: 212-591-7836, Fax: 212-591-7441, E-mail: engfnd@aol.com, WWW: www.engfnd.org.

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New Book: 'Design of Simple and Robust Process Plants – Jan Koolen

Recently published by Wiley-VCH, this 450 page text sets out to bring the features in its title, which are commonly found in other equipment, to the process plant. "A process plant should meet the simplicity and robustness of a household refrigerator." I find the comparison Jan Koolen makes between the domestic and industrial variants of refrigerators revealing – his use of statistics appeals to me! Some data extracted from the book are given in the Table below:

Feature	Domestic	Industrial
Safety devices	0	17
Instruments for control	1	58
Valves	0	120
MTBF (years)	>10	1

MTBF = Mean Time Between Failures

The author, who worked for many years at the Dow Chemical Company in the Netherlands, claims that the approaches to process plant design described in his book should lead to plants requiring 30-40% less capital than usual. This fact should ensure that the payback period on the £95 cost of the book will be acceptable to even the most conservative company accountants!

With an extensive Introduction and 10 other Chapters, ranging from design philosophies through process synthesis, instrumentation, automation and optimisation, the book is both wide-ranging and detailed in its analysis of process plant functions and their analysis. For the reader interested in process intensification, the book is replete with explanations and examples, including specifically Chapter 5 – Process Simplification and Intensification Techniques.

The section in Chapter 5 'Intensification of Process Functions' takes Colin Ramshaw's ground-breaking work at ICI as the starting point for a discussion of four major features of PI – compact heat and mass exchangers, increased heat, mass and impulse transfer, centrifugal force benefits (HiGee) and overall process improvements. The last topic leads us to the methods for process simplification which can be applied to process design. Energy integration and

unit operation combinations feature strongly in this Section, with examples taken from separations, reactions, heat transfer and fluid flow, and piping/instrumentation.

It is revealing that PI is regularly discussed in the context of process simplification – in particular where the latter involves combined unit operations. If the book can be said to have one important message for this reviewer, it is that intensified plant can (and should) be simple plant.

For the engineer with time to study this text, the benefits for his/her work should be substantial. It is readable, well-illustrated, contains comprehensive references and a good index. It is also topical. DAR.

J.L.A. Koolen. Design of Simple and Robust Process Plants. Wiley-VCH, 2001. ISBN 3-527-29784-7. Available £95.00 from John Wiley & Sons, Chichester, UK.

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Recent Literature & Patents

In this regular section of PIN News, recent publications are briefly reviewed, and patents believed of interest to readers are identified. The Editor invites contributions identified by PIN members in order to increase awareness of PI activities world-wide. The transfer of technology from one sector to another allows you to eliminate unnecessary R&D, and helps the solution of problems which may be outside your normal areas of experience or expertise. Some of the reviews are obviously aimed at encouraging this. In this issue, some additional patent web sites are detailed - data which first appeared in HEXAG News issue 13 and which will be incorporated in the forthcoming 'Guide to Process Intensification'.

"Searches in all databases can be done on the basis of key words for the technology, patent numbers, (where known), companies or inventors. Care should be taken in ascertaining where 'free' access stops and charges begin, e.g. for ordering the full patent specification.

The UK Patent Office has its own web site, offering a variety of facilities. Free access to patent abstracts and other services is available: http://www.patent.gov.uk/

Once onto the UK Patent Office Home Page, directions to the patent search are given. On clicking on this, one is given access to the interface to the published patent application databases of the UK Patent Office, the European Patent Office and other European national patent offices. There is also access to the database of published patent applications: Esp@cenet

Full copies of the specification, drawings and claims can be viewed on line, if they are available. Using a key word search for compact heat exchangers, for example, the user will find patent abstracts from Eastern and Western Europe, as well as the USA.

Perhaps the best data sources for patents, in terms of web accessibility and ease of searching, are those associated with United States Patents. Abstracts, and other limited access is free of charge, (except for your own web time charges) at two sites:

http://www.uspto.gov/ - This is the United States Patent and Trademark Office Home Page and is the official site for searching the US patent database.

*http://www.delphion.com The Delphion Intellectual Property Network also lists US patents, searchable by key words, patent numbers, assignees, etc. *(Note that this has now replaced the IBM patent web site address listed in the last issue of HEXAG News).*

For access to more specific data sources on patents, such as vehicle patents, use the web search engine with key words such as 'patents' or "US patents' to obtain a full listing.

One useful feature of some patent databases is that you can view a picture of the device being patented - not available with most abstract services, such as the one I use for the abstracts below. Patents are one area where a picture is worth many thousands of words!"

US Patent 06303825 Method of starting up loop reactor systems in which at least one exothermic reaction is to be carried out. Assignee: Phenolchemie GmbH & Co. KG. Published 16/10/01.

The present invention provides a method of starting up a loop reactor system, which method includes heating a reaction mixture present in the loop reactor system with the heat of reaction of at least one exothermic reaction occurring in the loop reactor system. The method of the invention makes possible an inexpensive, reliable and simple start-up of loop rector systems, since the heat liberated when carrying out an exothermic reaction is utilized for heating the reaction mixture present in the loop reactor. Use of the method of the invention makes it unnecessary to switch heat exchangers over from coolant to heat transfer media such as steam. Since the method of invention is able to heat up the reaction mixture in the loop reactor system more rapidly than in conventional methods, the number and the amount of by-products formed by secondary reactions during the start-up phase is reduced. In addition, the method of the invention reduces the corrosive stress on the heat exchangers since none of the heat exchangers need be at a temperature significantly higher than the temperature of the reaction mixture in the loop reactor system.

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Intensification of leaching process by dual-frequency ultrasound- K.M. Swarmy and K.L. Narayana. Ultrasonics Sonochemistry, Vol. 8, Issue 4, pp. 341-346, 2001.

Abstract

Ultrasound is gaining importance in metal extract process. In the previous laboratory scale investigation the authors have established the positive influence of ultrasound on copper recovery from oxide ores of Malanjkhand, Madhya Pradesh, India in an ammonical media. The process parameters in a conventional agitation method were optimised and a maximum recovery of 32% in 20 min was obtained without sonification. The recovery was increased to 78% by the application of ultrasound over the same period with several advantages like decrease in leaching time and the regent consumption. In the present study the leaching process is intensified by studying the metal recovery variation at different ultrasonic frequencies (20, 40, 43 and 720 kHz) and intensities (up to 8 W cm-2) with sonification time. The results show that sinusoidal ultrasound even at larger intensity has some limitations with single frequency. However, simultaneous application of dual frequency 20 and 40 kHz ultrasound enhanced extraction rates along with increased yield. While conventional single frequency exposure at either one of the two frequencies at the same acoustic power did not yield similar results, application of two wave sources, as used in the study revealed that it is possible to save energy through lowering of time of operation process.

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Magnetic-laser activator. Vadim, F. World Textiles, pp. 557-558, 2001.

Abstract

The present article studies the problems of magnet fields laser radiation usage aimed at cotton and mixed fabrics continuous dyeing and finishing processes intensification, The study of dyestuffs and finishing reagents in solutions and in fibres under the magnet field influence proved, that magnet-treated water usage, which is most common in this country's technologies, is the least effective. We propose the simultaneous magnet treatment of technological solution and fabrics, absorbing dyestuffs, which is more effective as the dyestuff content in fibres increases up to 15… 35% instead of 5% in the traditional method. Herewith the direct magnet influence during absorbing is preferable as the negative factors are partially excluded (solution structural changes are in less degree depended on solution stirring, batch filling and others). The liquid velocity in the magnet field is defined by certain parameters, i.e. magnet field intensity limits from 80 up to 240 kA/m and movement velocity, temperature etc. The researches proved that cotton fabrics direct dyeing in the magnet field temperature reduction increases the dyeing intensity by 15… 30%. Sewage water less contamination makes an important side effect. Colours durability correspond to GOST norms. It was stated, that drying intensity is 1.2 times higher, when the magnet field was applied, irrespectively of application time (to solution or to absorbing fabrics).

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Process intensification using multifunctional reactors. F. M. Dautzenberg and M. Mukherjee. Chemical Engineering Science. Volume 56, Issue 2, Pages 251-267, January 2001

Abstract

Process Intensification is the strategy of making significant reductions in the size of a chemical plant in order to achieve a given production objective. Innovations in catalytic reactors, which constitute the heart of such process technologies, are often the preferred starting point. Over the last two decades, innovative multifunctional reactor systems have been developed to intensify chemical processes by synergistically combining chemical reaction with momentum, heat and mass transport in a single vessel. This paper aims to emphasise an interdisciplinary approach to multifunctional reactor design. Examples from commercially practised technologies are used to illustrate how **process intensification** can be achieved through multifunctional reactors. Furthermore, new developments in this area will be highlighted.

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Modelling and test of a thermally-driven phase-change nonmechanical micropump. Y J Song and T S Zhao. J. Micromech. Microeng. 11 (2001) 713-719

Abstract

A thermally driven phase-change non-mechanical micropump has been investigated theoretically and experimentally. This micropump consisted of a microchannel and a number of uniformly-spaced heating elements along the channel. The pumping of fluids in such a pump was realised by using the actuation of a moving vapour slug (bubble) generated by suitable phased heating elements. The pumping mechanism was studied theoretically by considering a liquid-filled tube heated locally by a moving heating source. To verify the theoretical analysis, a pumping device consisting of a microchannnel with twelve embedded heaters along the channel was fabricated and tested using deionised water as the working fluid. The experimental results indicate that this simple micropump can achieve a maximum pressure head of 57 mm H2O and a maximum volumetric flow rate of 300 u1 min-1 when it is operated for a heating power ranging from 8.0 to 12.0 W and a heating time of about 3 s. It is found that the theoretical model is in reasonable agreement with the experimental data.

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Intensification of Phase Transition on Multiphase Reactions. Zhen-Min Cheng, Abdulhakeim M. Anter and Wei-Kang Yuan. AIChE Journal, Volume 47, Issue 5 Pages 1185-1192, May 2001

Abstract

Chemical reactions, generally conducted under full gas or liquid phases, are problematic for volatile liquid reactants. For such reactants, the presence of phase transition can be favourable, since evaporation of the liquid could not only balance the reaction heat but improve the effectiveness factor of the porous catalyst. This principle was applied to engineering applications. Experiment was carried out to investigate effects of catalyst activities, flow directions, operation pressures, gas and liquid flow rates, and reactant concentrations on the reactor behaviour. Quench operation with cold-injection side stream was initiated to prevent an excessive temperature rise, which was shown to be effective and flexible. With this novel optimising method, the reactor temperature could be kept around 270 oC under 1.0 MPa, even with a benzene concentration of 35%. Research on phase transition of benzene hydrogenation proved successful and could be extended to reaction systems with a similar range of **process intensification.**

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MEETINGS/CONFERENCES

United Engineering Foundation Conference on Process Innovation & Process Intensification - (PI)^2, Edinburgh, 9-13 September 2002.

Watch the PIN Web Site and see the announcement above in this issue.

International Conference on Process Intensification and Miniaturisation in Biological, Chemical, Environmental; & Energy Conversion Technologies. (PIM 1) – 18-21 August 2003. Newcastle University.

The First Announcement is imminent. Full details will be given on the PIN Web Site soon. Prof. Galip Akay, who chaired the Nottingham intensification conference in 1995, chairs this Conference Committee. Email: Galip.Akay@ncl.ac.uk

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PI Course

BHR Group/Cranfield University are running a course on PI from 8-12 April 2002. Full information from Andrew Green at BHR Group: **agreen@bhrgroup.co.uk**

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Announcement

AICHE CONFERENCE IN MEXICO in 2002 – Novel Reactors, Process Intensification & Sustainability

In March of 2002 (March 18-20), AlChE will be hosting an international conference in Mexico City, in conjunction with the ACHEMAMERICA exhibit put on by DECHEMA. One of the broad topics to be covered will be:

Novel Reactors, including Separate Reactors, Micro-Reactors, Vortex Reactors, etc. as well as Process Intensification and Novel Unit Operations for a sustainable Future.

We expect the audience to be highly international – with many Mexicans, Latin Americans and Europeans as well as USA scientists and engineers. We are now preparing a Call for Papers, and would like to know in advance whether you might be interested in making a presentation or helping to organise such a session.

For information, contact:
e-mail: :jackw@aiche.org
Web: http//www.aiche.org

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CALL FOR PAPERS

Piloting for Process Intensification & Miniaturisation – AIChE Fall National Meeting, Indianapolis, USA, 3-8 November, 2002.

The inevitable trend towards miniaturisation and process intensification, strategies designed to dramatically reduce equipment size and boost production efficiency, will have a profound influence on process plant design and operation in the future. Process intensification has the potential to deliver major benefits to the process industry, and many other sectors, by accelerating the response to market changes, facilitating scale-up and providing the basis for rapid development of new products and processes. Additional benefits include reduced capital cost, improved intrinsic safety and reduced environmental impact. You are invited to share your experiences in piloting Process Intensification and Miniaturisation in the following suggested (but not exclusive) areas of interest:

- smaller, cleaner, and more energy efficient processes
- novel technologies with oscillatory flow and microchannels
- novel equipment like static mixers, monolithic catalysts, microreactors, compact heat exchangers and rotating devices like spinning-disk reactors and HIGEE separators
- combined unit operations, multifunctional reactors, hybrid separations and the use of alternative energy sources like microwave heating

Please submit your abstract by April 26, 2002 at www.aiche.org, or to:

David Edwards, Zeton Inc. dedwards@zeton.com
Or Eric Townsend of Xytel Corp.: etownsend@xytelcorp.com

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The Next *PIN News*

The next PIN News will be issued in August 2002. Please send your contributions to David Reay by mid-July 2002.

THE NEXT PIN MEETING- THE NEXT PIN MEETING- THE NEXT PIN MEETING- THE NEXT PIN MEETING- THE NEXT PIN MEETING

DATE: 23 MAY 2002.

VENUE: NEWCASTLE UNIVERSITY.

Full information and registration forms will be sent to all PIN members in late April, 2002.