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OZONE

"STRIVE TO PROTECT EARTH"

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A TECHNICAL MAGAZINE

BY

DEPARTMENT OF CHEMICAL ENGINEERING

GAYATRI VIDYA PARISHAD COLLEGE OF ENGINEERING

(AUTONOMOUS)

IIChE STUDENT CHAPTER

Ozone Team

Prathyusha Vedula

16131A0842

Chief Editor

&

Magazine coordinator

Bondala vishal

16131A0804

Tech support

Nikhil binani

17131A0838

Article contributor

P V V Mahadesh

17135A0809

Article Contributor

B Gangadhar

16131A0810

Article contributor

Ozone Team

Ozone Faculty Coordinators :

1. Dr. B. Srinivas, Professor
2. Dr. M. S. N. Murty, Professor & Head of the Department

IIChE-GVPCE(A) SC Faculty Coordinators :

1. Dr. C. V. Nageswara Rao, Associate Professor
2. Mr. G. Naga Chaitanya, Assistant Professor

Quiz Courtesy,

Dr. B. Sivaramakrishna, Assistant Professor

Ozone Team (Edition 1.0)

1. Prathyusha Vedula (4th Year) (Chief Editor & Magazine Coordinator)
2. B. Vishal (4th Year) (Tech Support & Design Coordinator)
3. B. Gangadhar (4th Year) (Article Contributor)
4. Nikhil Binani (3rd Year) (Article Contributor)
5. P. V. V. Mahadesh (3rd Year) (Article Contributor)

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BIOGRAPHY

Robert Samuel Langer

A Living Legend!

Langer was born August 29, 1948 in Albany, New York, USA. He is an alumnus of The Milne School and received his bachelor's degree from Cornell University in chemical engineering. He earned his Sc.D. in chemical engineering from MIT in 1974. His dissertation was entitled "Enzymatic regeneration of ATP" and completed under the direction of Clark K. Colton. From 1974–1977 he worked as a postdoctoral fellow for cancer researcher Judah Folkman at the Children's Hospital Boston and at Harvard Medical School. Langer credits Folkman as a fantastic role model.

Langer is widely regarded for his contributions to medicine and biotechnology. He is considered a pioneer of many new technologies, including controlled release systems and transdermal delivery systems, which allow the administration of drugs or extraction of analytes from the body through the skin without needles or other invasive methods.Langer worked with Judah Folkman at Boston Children's Hospital to isolate the first angiogenesis inhibitor, a macromolecule to block the spread of blood vessels in tumors. This discovery is considered to lay the foundation for much of today's drug delivery technology. He also worked with Henry Brem of the Johns Hopkins University Medical School on a drug-delivery system for the treatment of brain cancer, to deliver chemotherapy directly to a tumor site. Langer is regarded as the founder of tissue engineering in regenerative medicine. Langer holds over 1,350 granted or pending patents. He is one of the world's most highly cited researchers, having authored over 1,400 scientific papers, and has participated in the founding of multiple technology companies.

A BRIEF DESCRIPTION

DEPARTMENT OF CHEMICAL ENGINEERING

The Chemical Engineering Department of GVPCE was established in the year 1996 and was twice accredited by NBA in 2003 and 2008 for 5 years. The Department offers UG & PG course. It has faculty with good academic and industrial background, who are dynamically engaged in teaching, research and industrial interaction.

Presently, out of the 13 faculty members, 7 are Ph. D holders and one awaiting to be conferred Ph.D. About 62 papers have been published in the last 5 years in various international and national journals. The faculty is actively engaged in R & D activities relating to Catalysis, Multi Objective Optimization, Three Phase Fluidization, Fuel Cell, Process control, Membrane separations, Bio Fouling, essential oils, precursors for carbon fibers and Corrosion, synthesis of Nanoparticles.

The department is also keeping abreast the students of the present day developments in the application of software for Chemical Engineering by mastering the state of the art software packages like COMSOL for CFD, PRO II for Chemical Process simulation, MATLAB for general simulations and a Real Time Simulator.

The students of the department are regularly trained on these softwares so as to enable them in visualizing the various possible scenarios. This has helped many of the students getting offers from companies like FLUENT, Reliance, HPCL, BPCL, Invensys and also being offered 6 summer fellowships in IITs and IISc in the last 5 years.

SUCCESS STORY OF AN ALUMNI

Sudarshan Konidena

An alumni of GVP

When I pause and look back with curiosity at the road traversed, the long path takes me to the people & events that occurred at GVP, my Alma mater. A major aspect of difference to me is the kind of nurturing one gets at the most active stage of life. I had the opportunity to spend this stage of my life at the Chemical Engineering Department alongside peers who still continue to inspire me alongside others in various walks of life.

One cannot ask for a better place than the chemical engineering department to shape up a young mind to become prepared to know himself. I consider myself lucky to have been trained under the lights of Dr.B.Srinivas, Dr.M.S.Rao, Dr.Bhaskara Sharma among others. I should specially thank Dr.Badri for making me appreciate the importance of math for chemical engineers which propelled me to pursue research in fluid mechanics. The efforts made by the department to keep the students and academic curriculum abreast with the state of the art simulation software are extremely commendable. Numerous workshops that I attended helped me gain hands on experience in various simulation softwares like COMSOL,STAR-CCM+,ASPEN PLUS,etc. A few seminars given by my GVP Alumni pursuing research at prime international institutes motivated me in focusing my energies towards higher education.

Apart from the usual academic stuff, a few industrial visits had given me & my colleagues several insights on the application of the basic engineering principles in industry. Under a watchful supervision of the faculty members of the department, I effortlessly managed to slip into the Master's Programme in IIT Madras. After successful completion of my grad school under the guidance of Dr.S.Pushpavanam, I went on to pursue my doctoral research in IIT Guwahati in the field of low Reynold's number Fluid Mechanics. With the same intrigue that Dr.Badri instilled me within the area of fluid mechanics, I am now about to join IIT Madras for a Post-Doctoral opportunity in pursue further research in active fluids.

INTERNSHIP EXPERIENCE AT IIT

IIT-Guwahati,
Md.Abdullah and T.Narendra Naidu
(4th year)

Internship at IIT Guwahati was one of the most fortunate things that happened to us. It taught us many things about life, people and culture and most importantly revealed where we, as chemical engineers, stand in this vast world of amazing opportunities. We worked on different projects under different professors guidance. We constantly worked for betterment. Betterment can be defined in different aspects in a different point of view but the one that matters the most, at least to us, is self-actualization and we found it.

The topics we worked on were the absorption of carbon dioxide in different solvents(Abdullah) and synthesis of nanocrystalline zeolite using ionothermal method(Narendra). My topic at IITG was all about carbon dioxide and how it is absorbed into different kinds of solvents like NaOH, KOH etc. My project's main focus was on using NaOH as the absorbent and proving that it is cheaper and more economical the presently used MEA(monoethanolamine).

Experimenting: In this process of experimenting, we prepare a 0.1N pure NaOH solution and take it in a round bottom flask, bubble carbon dioxide gas for different durations of time. Then take that bubbled NaOH solution and titrate it with 0.1N HCl solution in accordance with warders titration method. This procedure involves both KMnO4 and Methyl Orange as indicators. The procedure gives us the exact amounts of sodium carbonates and bicarbonates which in turn gives us the ability of NaOH to absorb carbon dioxide. The solution is also tested using XRD which gives us the amount of trona production which is also a part of carbon dioxide production. Now, this whole process is repeated for different concentrations of NaOH and carbon dioxide.

Experience: There seems to be a lot of difference between industrial internships and research internships and definitely both of them have their unique value and experience. But to us, I can say that it tested our abilities, basics and made us ready for our future plans of research. We are thankful to everyone who helped in guiding us this way and hope that our juniors would also utilize such wonderful opportunities and get benefitted.

SOFTWARE FOR CHEMICAL ENGINEERING

MATLAB TO OCTAVE

Next Level of Coding for Chemical Programmers !

Chemical engineering students, usually use MATLAB for some of their coursework, especially for numerical computations, plotting and so on. MATLAB does perform very well in terms of computation but requires the user to have an academic or professional license, which many students/ institutions cannot afford. An alternative to this problem is GNU Octave.

From the GNU Octave site,
GNU Octave is a high-level language, primarily intended for numerical computations. It provides a convenient command line interface for solving linear and nonlinear problems numerically, and for performing other numerical experiments using a language that is mostly compatible with Matlab. It may also be used as a batch-oriented language.

Octave has extensive tools for solving common numerical linear algebra problems, finding the roots of nonlinear equations, integrating ordinary functions, manipulating polynomials, and integrating ordinary differential and differential-algebraic equations. It is easily extensible and customizable via user-defined functions written in Octave's own language, or using dynamically loaded modules written in C++, C, Fortran, or other languages.

Students/ teachers can download this software from downloads page on GNU Octave. The GUI and commands used in Octave are very similar to MATLAB. The users can also open and use the .m files from MATLAB in Octave. The transition from MATLAB to Octave can be very smooth.

Here is a little fun fact – Octave was initially designed to solve the problems for a Chemical Reaction Engineering course. As a tribute to Prof. Octave Levenspiel, Dr. John Eaton - the original creator of Octave, decided to name the software after him.

DEVELOPMENT OF ANTI-FOULING COATING USING IN MARINE ENVIRONMENT

Smash the Snag!

The marine organism attaching to the ship hull would slow down the ship and increasing fuel consumption. In order to prevent the problem, anti-fouling paints are used to coat the bottom of ships. In order to solve this problem, the researchers used a variety of methods.and the most effective way is to use coating containing toxic substances such as three tributyltin. The anti-fouling paint which contains three TBT has good killing effect, and it can release slowly from the surface of the hull so that they could use for 5 years. At the same time, the harmful environmental effects of these paints have been recognized. And so, researchers began to develop new anti-fouling paint. In this study, the traditional anti-fouling coatings and the latest research progress are summarized respectively.

Silicate Anti-fouling Coatings

Silicate anti-fouling paint is one kind of anti-fouling agent of soluble alkali silicates, which may form strong alkaline region between the hull surface and sea areas of the paint in contact. The suitable habitat pH for marine fouling organisms is 7.5-8.0 in slightly alkaline seawater, and it is not fit for them in alkali or acid environment. Silicate could become the anti-fouling agent (such as zeolites, crystallization alumina silicate with containing water), and its anti-fouling mechanism may be the ion exchange or molecular sieve effect. During the process, ion exchange happens between silicate and H+ which comes from seawater. Then anti-fouling agent is released and anti-fouling function is achieved. This way is not only the feature for cheap, efficient, no environmental hazards, but also could not be affected by climate change and the marine environment. The Institute of Chemical Technology of Qingdao Ocean made the non-toxic anti-fouling paint powder which was based on alkaline silicate and other additives, and it could be easy to carry and could be saved for 2 years. At the same time, the powder has a good anti corrosive effect after mixed with resin, and its anti-fouling deadline could be more than two years.

Capsaicin Anti-fouling Agent

Capsaicin is separated from pepper fruit. It was named by Thresh in 1876 and its structure was determined by Nelson in 1919. It is the main substance of spicy flavor in chili and it is
the stable alkaloid. Also, it has the function of antibacterial and could prevent the growth of marine organisms. So far, domestic and foreign researchers have done a lot of research
for spicy type of natural antifouling agent. Anti-fouling paint with capsaicin achieves the purpose of anti-fouling by driving effect. The effective components of it could be released slowly through release control technology and achieve long-term and safe anti-fouling effect.

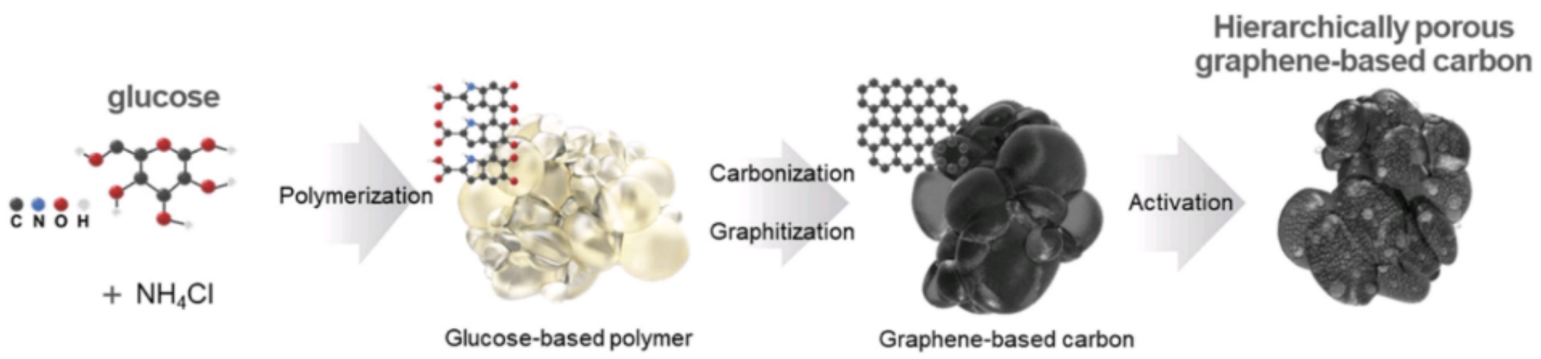
Fischer used pepper derivative for anti-fouling agent (e.g. red capsaicin or oleoresin capsaicin) and added it to an ordinary waterproof paint to synthesize the anti-fouling paint
which could prevent marine organisms fouling.Yan et al synthesized three acrylamide compounds derived from capsaicin. They found that all the three compounds possessed
good antibacterial activities with MIC value of BMA. These compounds were also studied as antifouling agent in anti-fouling paint, and test panels immersed for 186 days was almost free of marine organisms. The result showed that it could prevent the adhesion of marine organisms.

AN INNOVATION

ACTIVATED BIOMASS-DERIVED GRAPHENE BASED CARBONS FOR SUPERCAPACITORS WITH HIGH ENERGY AND POWER DENSITY

Inking Innovations

A facile and low-cost method to produce hierarchically porous graphene-based carbons from a biomass source. Three-dimensional (3D) graphene-based carbons were produced through continuous sequential steps such as the formation and transformation of glucose-based polymers into 3D foam-like structures and their subsequent carbonization to form the corresponding macroporous carbons with thin graphene-based carbon walls of macropores and intersectional carbon skeletons. Physical and chemical activation was then performed on this carbon to create micro- and meso-pores, thereby producing hierarchically porous biomass-derived graphene-based carbons with a high Brunauer-Emmett-Teller specific surface area of 3,657 m2 g−1. Owing to its exceptionally high surface area, interconnected hierarchical pore networks, and a high degree of graphitization, this carbon exhibited a high specific capacitance of 175 F g−1 in ionic liquid electrolyte. A supercapacitor constructed with this carbon yielded a maximum energy density of 74 Wh kg−1 and a maximum power density of 408 kW kg−1, based on the total mass of electrodes, which is comparable to those of the state-of-the-art graphene-based carbons. This approach holds promise for the low-cost and readily scalable production of high performance electrode materials for supercapacitors.



Schematic illustration of the synthesis of hierarchically porous biomass-derived graphene-based materials

CAREER GUIDE

OPTIONS AFTER GRADUATION-CHEMICAL ENGINEERING

What Next??

Work experience is a valuable way of getting first-hand knowledge of specialised industries. If you are undecided about the area of chemical engineering you want to work in, try to get an industrial placement to find out what's available. This may be a placement that’s part of your degree course, or one you set up yourself during the summer.Work experience is often available in the pharmaceutical, petrochemical and food and drink industries. Check out the careers section of company websites for more information.If you’re seeking relevant work experience abroad, look at the possibilities available through IAESTE (The International Association for the Exchange of Students for Technical Experience).

Higher Education

After holding a bachelor’s degree in Chemical Engineering, the graduates can apply for higher education in India or abroad. The higher education that can be done after a bachelor’s in Chemical Engineering are listed below

- M.E/M.Tech Chemical Engineering

After completing B.E/B.Tech in Chemical Engineering, interested candidates can pursue master’s degree in chemical engineering. It is a 2-year degree programme. A good score in Graduate Aptitude Test in Engineering (GATE) is a prerequisite for admissions into the top Indian Universities for M.E/ M.Tech Chemical Engineering programme. Some of the specialization courses in Chemical Engineering are Biotechnology, Pharmaceutical Engineering, Process Engineering, Nanotechnology, biomineral processing, polymer science and fiber and textile processing.

- MS

Interested students can also apply for MS in Chemical Engineering from India or abroad. Various disciplines in chemical engineering are polymer and complex fluids, biochemical and bioprocess engineering, catalysis and reaction engineering, etc. Other allied fields of Chemical Engineering are biotechnology, industrial engineering, environmental engineering, nanotechnology, etc.

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- Ph.D

Interested candidates can involve into the research activities in a concerned field and can obtain a Ph.D degree. Top research institutes and universities in India offers Doctor of philosophy in Chemical Engineering.

- MBA

Another alternative for Chemical Engineering graduates is MBA. To improve the management skills, reasoning skills and quantitative skills one can join MBA.

Career opportunities in Chemical Engineering

Wide opportunities are available for chemical engineering graduates at public and private sectors. The chemical companies hire chemical engineering graduates for the post of occupational health and safety specialists, chemical technicians, chemists, nuclear engineer, architectural and engineering managers, scientists, etc. The industries that hire chemical engineers are

- Petroleum, oil and gas companies
- Pharmaceutical companies
- Sugarcane factories
- Rubber and plastic industries
- Food manufacturing industries
- Health care industries
- Chemical and fertilizers industries
- Cement factories
- Paper and glass manufacturing industries
- Product manufacturing industries
- Textile industries

Government sector

Chemical engineering graduates has good career opportunities in government owned chemical industries, atomic power plants, fertilizer plants, textile industries, etc. Some of the government organizations which hire chemical engineering graduates are IOCL, SAIL, ISRO, ONGC, BPCL, HPCL, GAIL, OIL, etc. Graduates has opportunities in Pollution Control Board and are also involved in solving environment related issues such as waste treatment, wastewater management, recycling, energy conservation, etc.

Private sector

Opportunities are available for chemical engineering graduates in various chemical industries, pharmaceutical companies, and drug manufacturing industries, refineries, fertilizer manufacturing industries, etc. Some of the private industries which hire chemical engineering graduates are Biocon, Dr. Reddy's labs, Zuari fertilizers and cement, Tata Chemicals, HUL, ITC, Asian paints, Saint Gobain, etc. Chemical Engineering graduate who has an MBA also has opportunities to work as a project manager, operations manager, and production manager in private owned chemical industries and factories.

Research and Teaching

A lot of research activities are being conducted regularly at the research and development centers, research institutes and the top universities of India. Chemical Engineering aspirants can work as Junior Research Fellow (JRF), Scientists and Chemical technicians in the research centers. Graduates who have a passion for teaching can continue their career as a professor or lecturer in the department of chemical engineering at the top universities or educational institutes. Some of which are BARC, DRDO, NSTL etc.

Specialisation Related Jobs

There are many possible opportunities, but I would highlight on a few prominent ones:

- Process Design Engineer: A chemical engineering graduate can work in design companies be it detail design companies (Toyo, Petrofac, Flour etc) or in a licensing company (UOP, ABB, SHELL etc). Job of design companies is to design/commission/trail run and handover to client, projects they do are in oil/gas, refinery, petrochemical engineering and fertilizers.
- Technical Services Engineer: Chemical engineers are recruited in manufacturing companies/refinery for trouble shooting the plant problems and maintain steady plant operation. Companies such as HPCL, BPCL etc.
- Production Engineer: Again manufacturing companies hire chemical engineers as production engineers, who are expected to work in shifts and handle the plant production.
- Process simulation engineer: Automation companies and process simulation software companies such as Honeywell/Invensys/Aspen recruit chemical engineers for development of simulation softwares such as HYSYS, PRO-II.

● Piping design engineer: A chemical engineer can also work as a design engineer in the design companies. Chemical engineer has to do a piping design course after completing graduation. Few institutions offering such courses are Suvidya, MIT.
● Project Engineer: A chemical engineer can also work as a project engineer in the design companies, role of the project engineering will be more of maintaining coordination between client, all engineering departments for smooth execution of project.
● Indian Forest Services: For chemical engineers, instead of Indian engineering services government has special services for them which is forest services.
ISRO/LPSC: In LPSC chemical engineers are recruited as scientists for liquid propulsion system.
● BARC/DRDO/HPCL/BPCL/NPCIL: All these government companies recruit chemical engineers based in either GATE examination or conduct examination of their own.
● Software Engineer: When you are in your last year of chemical engineering, many IT companies offer jobs to chemical engineers to work as developer/tester

BRAIN TEASERS

QUIZ - Compiled by Dr. B.Sivaramakrishna

Head Stumpers!

1. Consider a control system with the open loop transfer function given by:

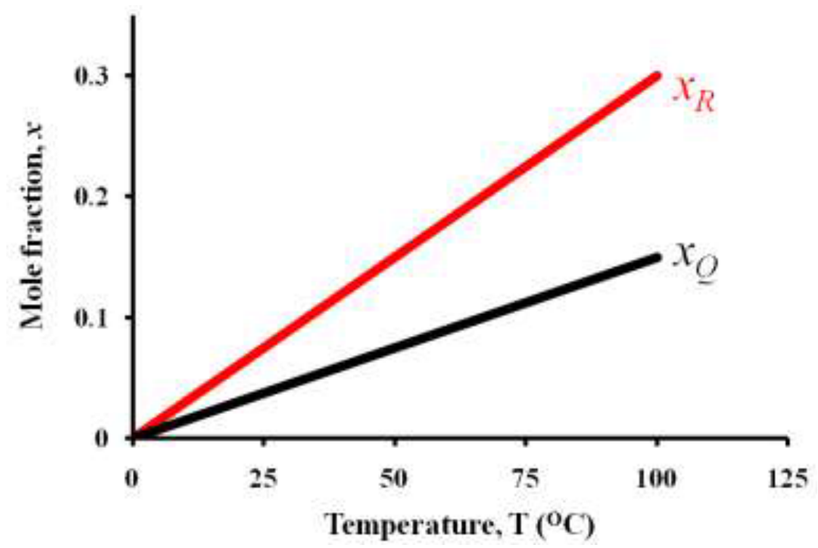
$$G_{OL}(s)=\frac{K_c e^{-0.3s}}{1.5s+1}$$

In the above function, pre-factor of s is in minutes and Kc is the gain of proportional controller. The frequency for phase margin of 30° is 4.04 rad/min. The value of Kc for a gain margin of 1.7 (up to one decimal place) is _____

2. In a laboratory batch setup, reaction of P over a catalyst was studied at various temperatures. The reactions occurring are

$$P \rightarrow 2Q \quad ; \quad P \rightarrow R$$

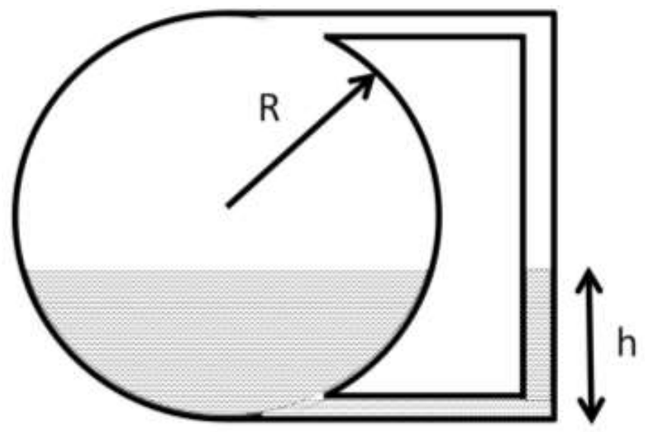
At the end of one hour of operation, the batch contains xP, xQ and xR mole fractions of P, Q and R components, respectively. The mole fractions of product components (xQ and xR) were found to vary linearly with temperature as given in the figure.



If the yield of Q based on reactant P consumed (YQ) at 25'C was found to be 0.40, then the value of YQ at 60'C is _____ (rounded off to second decimal place).

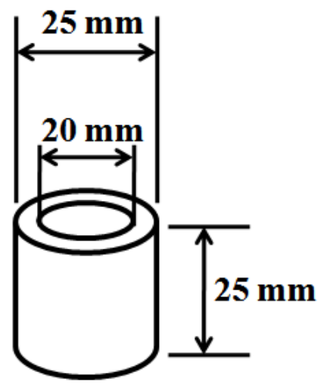
3. The volume of liquid filled in a spherical storage tank of radius R is computed from height of liquid, h, in the outside tube (neglecting the volume of liquid in the outside tube) as

$$V = \pi h^2 \frac{(3R - h)}{3}.$$

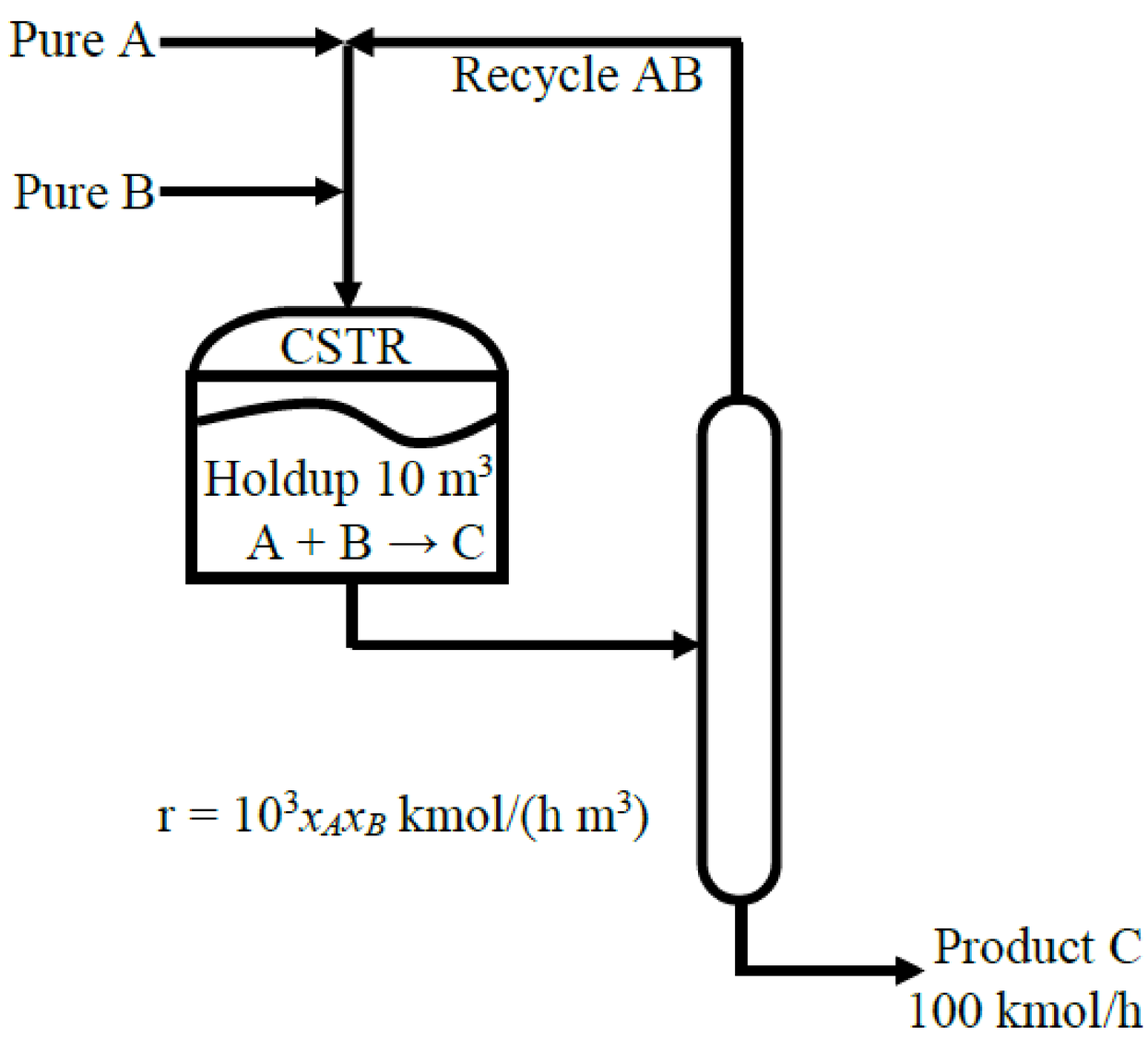


The estimate of liquid height (in m) to store V = 30 m3 of water in R = 3m tank, after performing ONE iteration of Secant method, using 1m and 3m as two initial guesses of liquid height is _____ (rounded off to second decimal place).

4. Hydrogenation of benzene is to be carried out using Ni (density = 8910 kg/m3) as catalyst, cast in the form of non-porous hollow cylinders, as shown below. The reaction occurs on all the surfaces of the hollow cylinder. During an experiment, one such cylinder is suspended in the reactant stream. If the observed rate of reaction is 0.39 mol (m2 of catalyst surface)-1 min-1, then the rate of reaction in mol (kg of catalyst)-1 min-1 is (rounded off to three decimal places).



5. Consider the reactor-separator-recycle process operating under steady state conditions as shown in the figure. The reactor is an ideal Continuous-Stirred Tank Reactor (CSTR), where the reaction A + B → C occurs. Assume that there is no impurity in the product and recycle streams. Other relevant information are provided in the figure. The mole fraction of B (xB) in the reactor that minimizes the recycle rate is_____ (rounded off to two decimal places).



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