THE FINAL WORD

The official e- newsletter of

Industrial Chemistry (IC) Department, ISTAR,
CVM University, Vallabh Vidyanagar, Anand, Gujarat

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INDUSTRIAL CHEMISTRY DEPARTMENT

Saraswati Pooja

A Saraswati Pooja was organized in our department on 27th June 2022 for welcoming of new batch and prayed for a wonderful beginning of new academic year.



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Industrial Chemistry Department

- ❖ **IC in News**

આઈસ્ટાર કોલેજ ખાતે સરસ્વતી પૂજા અને અભિમુખતા કાર્યક્રમ સાથે નવા સત્રની શરૂઆત

સૌરાષ્ટ્ર તહેલકા

સીવીએમ યુનિવર્સિટી સંચાલિત આઈસ્ટાર કોલેજના ઈન્ડસ્ટ્રીઅલ કેમેસ્ટ્રી (IC) વિભાગમાં તાઃ ૨૭/૦૯ ને સોમવારના રોજ સરસ્વતી પૂજા અને નવા પ્રવેશેલા વિદ્યાર્થીઓ માટે અભિમુખતા કાર્યક્રમનું આયોજન કરવામાં આવ્યું હતું.

આ કાર્યક્રમ અંતર્ગત સરસ્વતી માતાનું વિધિવત પૂજન કરવામાં આવ્યું હતું અને ત્યારબાદ વિભાગીય વડા ડો. જીગર પટેલ દ્વારા સંસ્થા પરિચય તથા નવા વિદ્યાર્થીઓનું સ્વાગત કરવામાં આવ્યું હતું.

કાર્યકામના અંતે પ્રીતિ ભોજનનું આયોજન રાખેલ હતું. સમગ્ર કાર્યક્રમને સફળ બનાવવા આઈસી ડિપાર્ટમેન્ટના સ્ટાફ અને સિનિયર વિદ્યાર્થીઓએ ખુબજ જહેમત ઉઠાવી હતી. સીવીએમ તરફથી ચેરમેન શ્રી ભીખુભાઈ સાહેબે તથા આઈસ્ટાર કોલેજના પ્રિન્સિપાલ ડો. કિરીટભાઈ પટેલ દ્વારા વિદ્યાર્થીઓને શુભેચ્છા-આશીર્વાદ પાઠવ્યા હતા.

આઈસ્ટાર કોલેજ ખાતે સરસ્વતી પૂજા અને અભિમુખતા કાર્યક્રમ સાથે નવા સત્રની શરૂઆત

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Article

REACTORS USED IN CHEMICAL INDUSTRIES

The reactors, in which chemicals are made in industry, vary in size from a few cm^3 to the vast structures that are often depicted in photographs of industrial plants. For example, kilns that produce lime from limestone may be over 25 meters high and hold, at any one time, well over 400 tons of materials.

The design of the reactor is determined by many factors but of particular importance are the thermodynamics and kinetics of the chemical reactions being carried out.

The two main types of reactor

1. Batch Reactors
2. Continuous Reactors

❖ Batch reactors:

Batch reactors are used for most of the reactions carried out in a laboratory. The reactants are placed in a test-tube, flask or beaker. They are mixed together, often heated for the reaction to take place and are then cooled. The products are poured out and, if necessary, purified.

This procedure is also carried out in industry, the key difference being one of size of

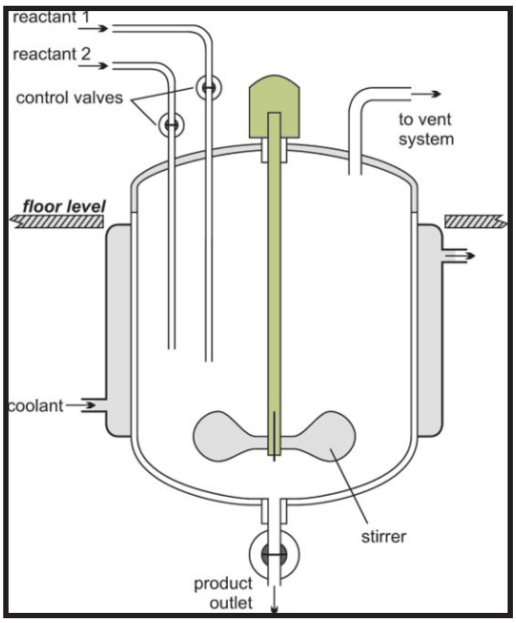

Figure 1: Illustrating a batch reactor.

Batch reactors are usually used when a company wants to produce a range of products involving different reactants and reactor conditions. They can then use the same equipment for these reactions.

Examples of processes that use batch reactors include the manufacture of colorants and margarine.

❖ Continuous reactors

An alternative to a batch process is to feed the reactants continuously into the reactor at one point, allow the reaction to take place and withdraw the products at another point. There must be an equal flow rate of reactants and products. While ***continuous reactors*** are rarely used in the laboratory, a water-softener can beregarded as an example of a continuous process. Hard water from the mains is passed through a tube containing an ion-exchange resin. Reaction occurs down the tube and soft water pours out at the exit.

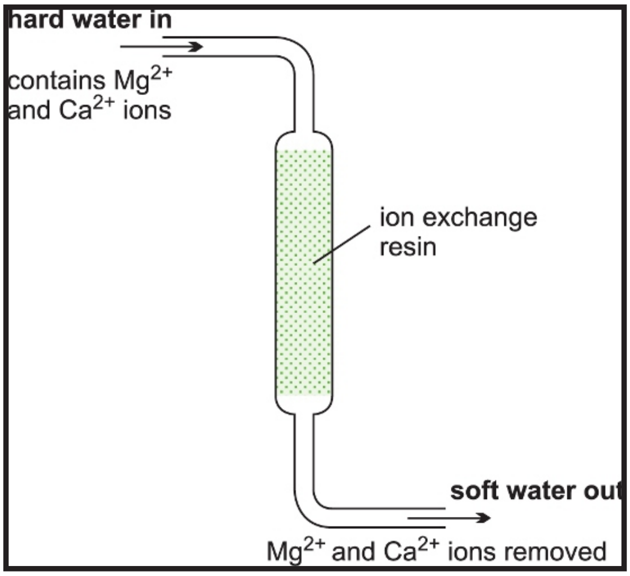

Figure 2: Illustrating a continuous reactor

Continuous reactors are normally installed when large quantities of a chemical are being produced. It is important that the reactor can operate for several months without a shutdown. The residence time in the reactor is controlled by the feed rate of reactants to the reactor. For example, if a reactor has a volume of 20 m^3 and the feed rate of reactants is 40 $m^3\ h^{-1}$ the residence time is 20 m^3 /40 $m^3\ h^{-1}$ = 0.5 h. It is simple to control accurately the flow rate of reactants. The volume is fixed and therefore the residence time in the reactor is also well controlled.

Types of continuous reactors:

1. Tubular Reactor
2. Fixed bed reactors
3. Continuous Stirred Tank Reactor
4. Trickle Bed Reactor

❖ Tubular reactor:

In a tubular reactor, fluids (gases and/or liquids) flow through it at high velocities. As the reactants flow, for example along a heated pipe, they are converted to products (Figure 3). At these high velocities, the products are unable to diffuse back and there is little or no back mixing. The conditions are referred to as plug flow. This reduces the occurrence of side reactions and increases the yield of the desired product.

With a constant flow rate, the conditions at any one point remain constant with time and changes in time of the reaction are measured in terms of the position along the length of the tube.

The reaction rate is faster at the pipe inlet because the concentration of reactants is at its highest and the reaction rate reduces as the reactants flow through the pipe due to the decrease in concentration of the reactant.

Figure 3 Tubular Reactor

A tubular reactor which is used in the production of methyl 2-methylpropenoate. The reactor is heated by high pressure steam which has a temperature of 470 K and is fed into the reactor at point 1 and leaves the reactor at point 2. The reactants flow through the tubes.

❖ Fixed bed reactors:

A heterogeneous catalyst is used frequently in industry where gases flow through a solid catalyst (which is often in the form of small pellets to increase the surface area). It is often described as a fixed bed of catalyst (Figure 4).

Among the examples of their use are the manufacture of sulfuric acid (the Contact Process, with vanadium (V) oxide as catalyst), the manufacture of nitric acid and the manufacture of ammonia (the Haber process, with iron as the catalyst).

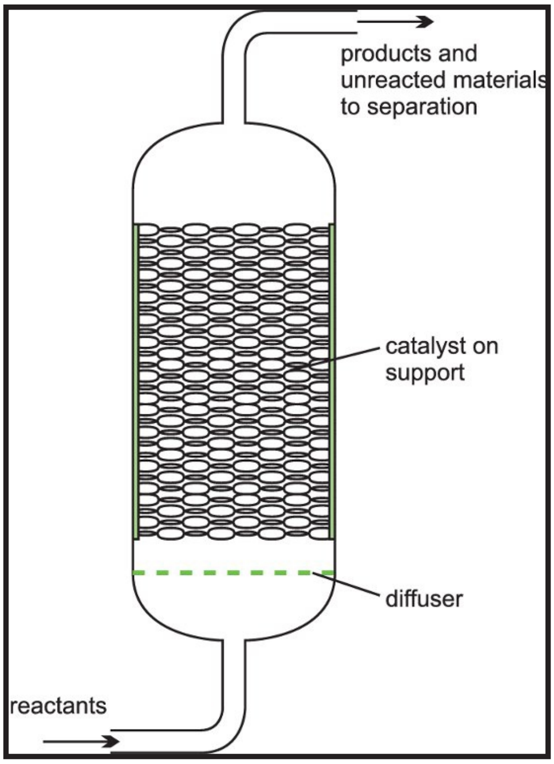

Figure 4 is the fixed bed reactor

❖ CONTINOUS STIRRED TANK REACTOR

The continuous stirred-tank reactor (CSTR), also known as vat- or back mixing reactor, mixed flow reactor (MFR), or a continuous-flow stirred-tank reactor (CSTR), is a common model for a chemical reactor in chemical engineering and environmental engineering. A CSTR often refers to a model used to estimate the key unit operation variables when using a continuous agitated-tank reactor to reach a specified output. The mathematical model works for all fluids: liquids, gases, and slurries.

The behavior of a CSTR is often approximated or modeled by that of an ideal CSTR, which assumes perfect mixing. In a perfectly mixed reactor, reagent is instantaneously and uniformly mixed throughout the reactor upon entry. Consequently, the output composition is identical to composition of the material inside the reactor, which is a function of residence time and reaction rate. The CSTR is the ideal limit of complete mixing in reactor design, which is the complete opposite of a plug flow reactor (PFR). In practice, no reactors behave ideally but instead fall somewhere in between the mixing limits of an ideal CSTR and PFR.

Applications:

CSTRs facilitate rapid dilution of reagents through mixing. Therefore, for non-zero-order reactions, the low concentration of reagent in the reactor means a CSTR will be less efficient at removing the reagent compared to a PFR with the same residence time. Therefore, CSTRs are typically larger than PFRs, which may be a challenge in applications where space is limited. However, one of the added benefits of dilution in CSTRs is the ability to neutralize shocks to the system. As opposed to PFRs, the performance of CSTRs is less susceptible to changes in the influent composition, which makes it ideal for a variety of industrial applications.

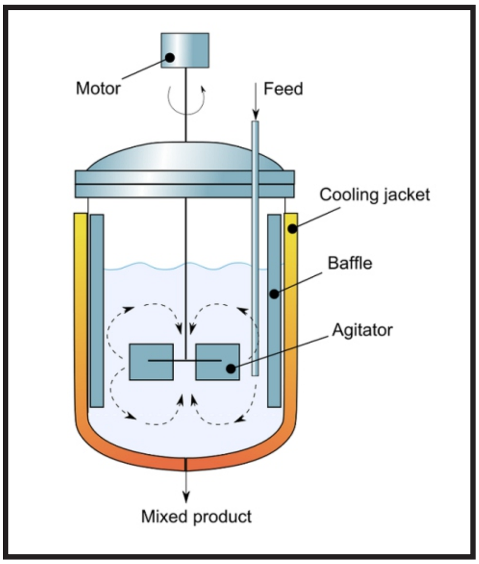

Figure 5 Continuous stirred tank reactor

❖ TRICKLE BED REACTOR

Trickle bed reactor is a semi batch process reactor. A **trickle-bed reactor** (**TBR**) is a chemical reactor that uses the downward movement of a liquid and the downward (co-current) or upward (counter-current) movement of gas over a packed bed of (catalyst) particles. It is considered to be the simplest reactor type for performing catalytic reactions where a gas and liquid (normally both reagents) are present in the reactor and accordingly it is extensively used in processing plants. Typical examples are liquid-phase hydrogenation, hydrodesulphurization, and hydrode nitrogenation in refineries (three phase hydrotreater) and oxidation of harmful chemical compounds in wastewater streams or of cumene in the cumene process. It is also used in the treatment of waste water trickle bed reactors are used where the required biomass resides on the packed bed surface.

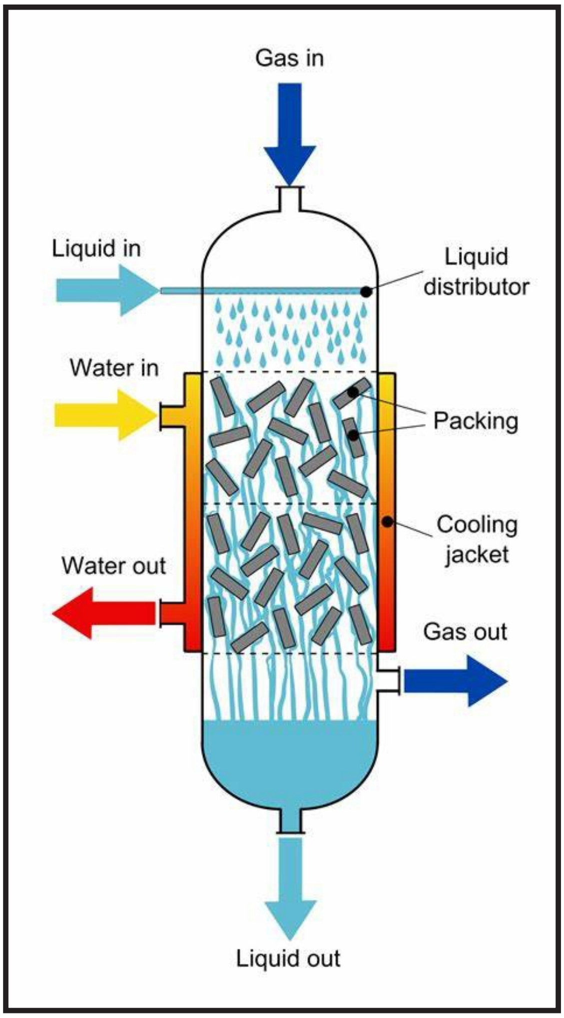

FIGURE 6 Trickle Bed Reactor

Sweet words from family

During my academic journey with Industrial Chemistry Department in ISTAR from 2002-2004, I had develop my knowledge in the field of organic chemistry, inorganic chemistry, physical chemistry , unit process and operations , pharma chemistry & last but not least analytical chemistry.

Industrial Chemistry Department has given a platform to students like me and had taken efforts in publishing scientific research article. From all the knowledge I had acquired during my academic tenure with Industrial Chemistry Department in ISTAR, it had helped me in pursuing my excellent professional career in pharma industry. During my professional career I have learnt many skills like analytical method development, process transfer, process validation, stability study and various skills in operating sophisticated analytical instruments and all this I could easily relate and achieve due to strong basic knowledge developed at Industrial Chemistry Department.

❖ My Thoughts for Industrial Chemistry Department

Industrial Chemistry Department has not only helped in developing my profile as a pharmaceutical professional but have also inculcated skills in me that would support me throughout my professional career.

Industrial Chemistry Department has a very helpful teaching faculty who do extend their knowledge and their 'guru mantras' whenever you ask them. Industrial Chemistry Department felicitation and continuous beckoning helped me grow. With great infrastructure, facility and constant support provided by the Management, HOD's and all the Professors helped my career grow.

❖ My Message

One may surely get to know the level of attention and support a student gets at Industrial Chemistry Department by surveying other institutes. If the student has great ideas and eager to fulfil his dream, Industrial Chemistry Department does provide opportunity for the student to excel...it is my experience!

Dr.Devang Niranjan Wadia
Managing Director:
DDS PHARMATECH PVT. LTD
LUCENT PHARMATECH LLp, Ahmedabad.