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Simulation of CSTR Using ASPEN PLUS Software

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ABSTRACT

This work gives a steady state simulation results of continuous stirred tank reactor using ASPEN-PLUS software. In our work we see the maximum conversion of ethyl acetate from its reactants. In this work we have seen how feed flow rate seen steady state behavior of CSTR and also we obtained optimum flow rate for the maximum conversion and yield with consideration of many reactions with one of the product of two is desired and another is undesired. Since effective reaction temperature is always a crucial in a exothermic reaction and optimum values are required for it and this values are found out by the simulation.

Key Words:- ASPEN PLUS, CSTR Temperature and Pressure effect on conversion, Sensitivity analysis.

Introduction:-

Reactor is a device which use some part of substance as a feed. After the responses given at a particular rate and uses a science gives a product as a output. Arrangement of this reactor and its working conditions are check to have maximum conversion at a less cost and less pollution and less by-product.

There are many types of reactors which are assured for the many conditions like physical and chemical aspects like nature of feed materials, temperature and pressure for the reaction etc. In a reactor chemical reactions relating to a chemical, petrochemical and oil industries are executed.

A chemical reactor have following functions:-

- Good resistance time for reactants for completing the chemical reaction.
- Gives good heat exchange.
- For a chemical reaction start it is need to all the phases are in contact.

CONTINUOUS STIRRED-TANK REACTOR:-The feed in the reactor in-which is fed is easily blended without any other properties e.g. spiral etc. The temperature is precisely same as feed is at all points of reactor. This conditions are same as feed of constant at any time and conditions.

The normal CSTR creates instantly the main characteristic of the CSTR is stirring. This stirring is uniform and mix the feed at any point is same.

ASPEN PLUS SOFTWARE USED:-

ASPEN PLUS V10 was used for the simulation.

ASPEN PLUS REACTOR MODEL:-

RCSTR Model was used for this work.

PROPERTY METHOD:-

CHAO-SEADER thermodynamic model was used in our simulation.

Problem Statement

The production of ethyl acetate is studied through the esterification of acetic acid with ethanol according to the reversible reactions:

$CH_3COOH + C_2H_5 \leftrightarrow CH_3COOC_2H_5 + H_2O$

Usually, the reaction is carried out in CSTR under atmospheric pressure and reflux temperature.

The existing kinetic for this reaction is of the power law type, with:

k_1 = 1.9E8, E_a = 5.95E7 J/kmol

k_2 = 5E7, E_b = 5.95E7 J/kmol

Variable	Value
Temperature	75 °C
Pressure	1 atm
Mass Flow, kg/h	
Water	160
Ethyl Alcohol	8600
Acetic Acid	11570

SIMULATION SETUP

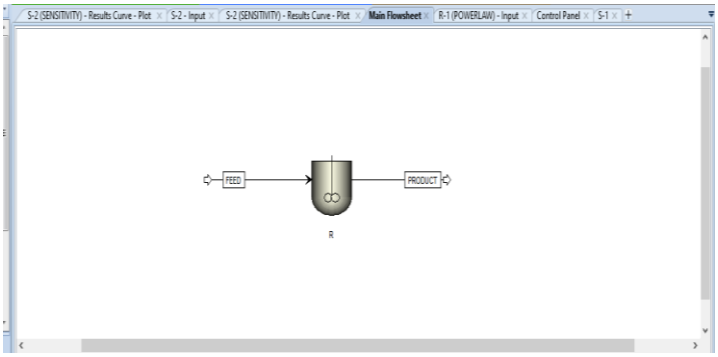

Fig.1

INPUTS TO ASPEN PLUS

- First open the ASPEN PLUS after that add the components as per statement. After that click on next.
- After that select the property method according to suitable conditions.
- Then click on next. After that click on simulation. After that draw the flowsheet.
- Then give the inputs to feed and the reactor. After that click on next.
- After that click on run the simulation and we get results.
- For checking the effects of temperature and pressure on the conversion click on the sensitivity analysis.
- After that select the run and add block variables and temperature and pressure rangers along with increments.
- After that click on run and we get results of conversion at each interval of temperature and pressure.

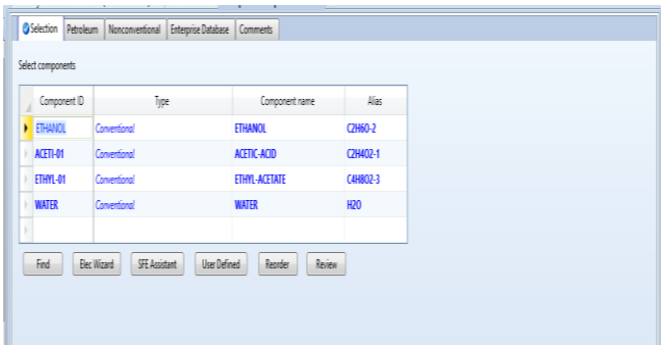

Fig.2

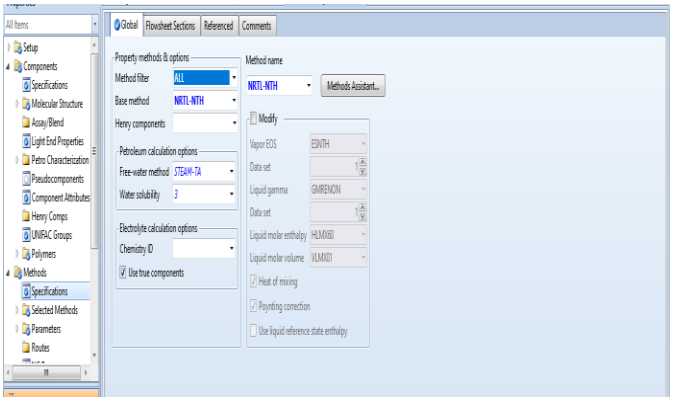

Fig.3

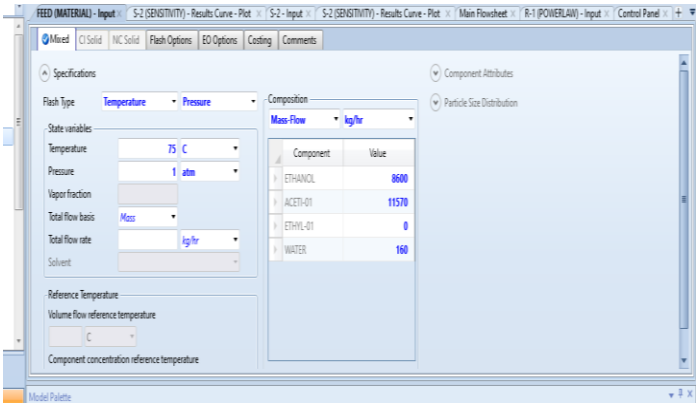

Fig.4

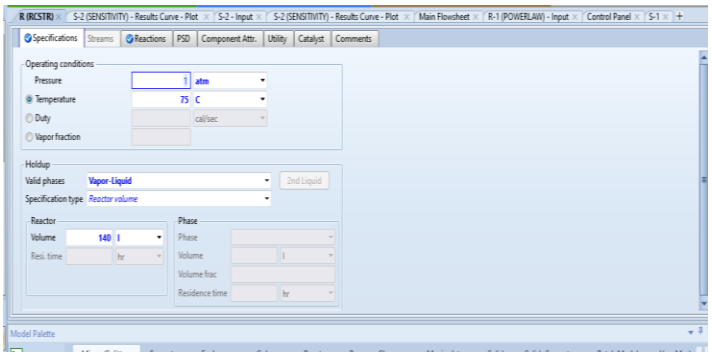

Fig.5

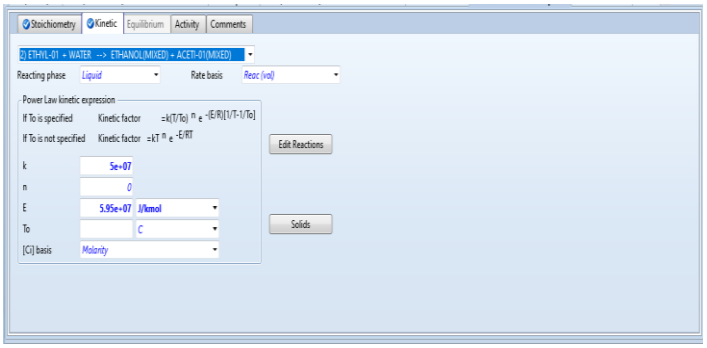

Fig.6

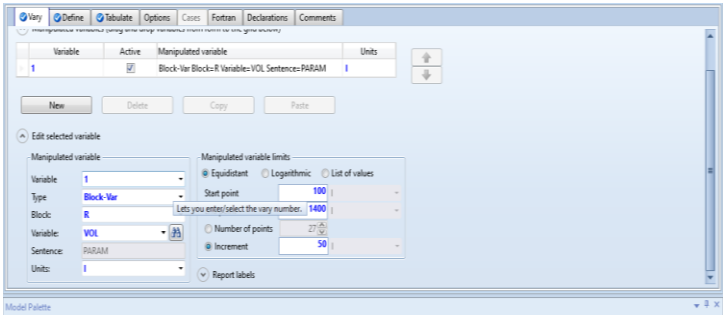

Fig.7

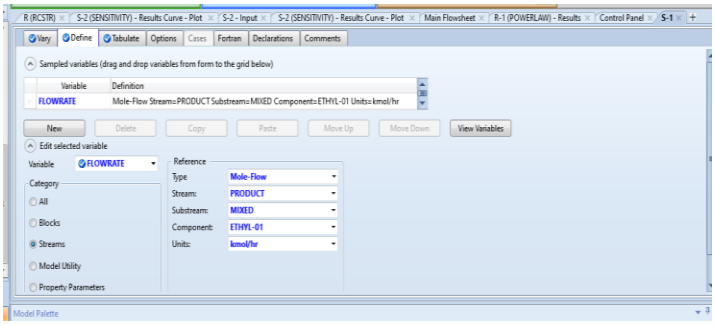

Fig.8

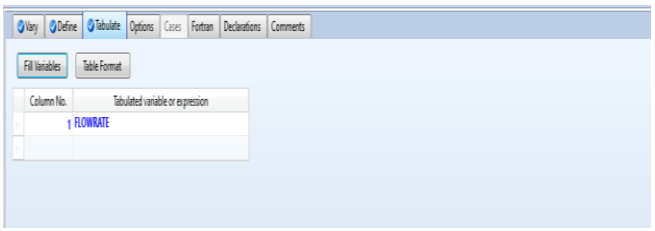

Fig.9

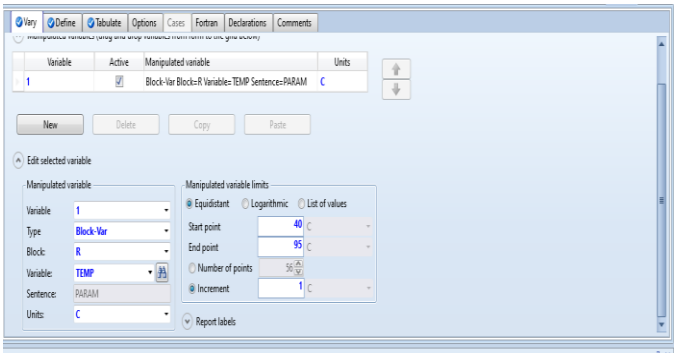

Fig.10

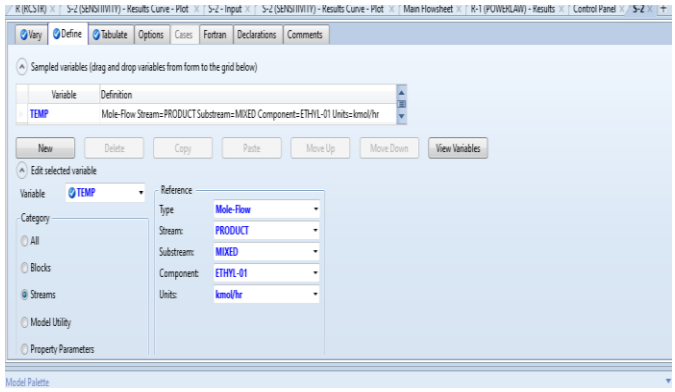

Fig.11

Fig.12

RESULT: -

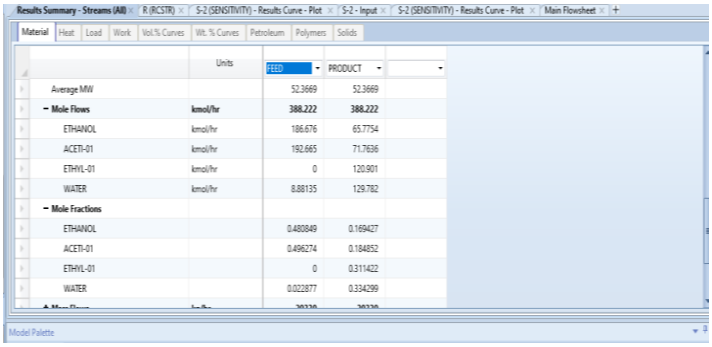

Fig.13

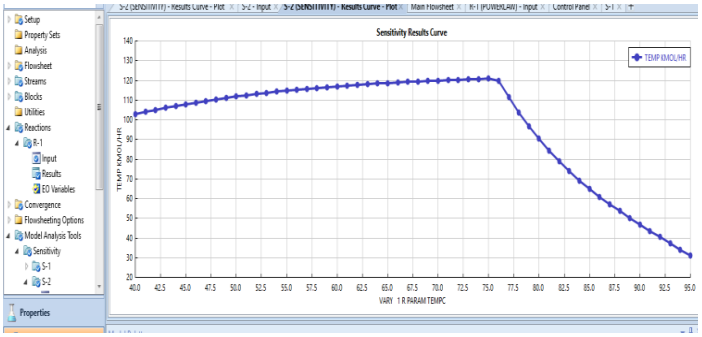

Fig.14

CONCLUSION:-

This project work gives steady state simulation results of a continuous stirred tank reactor system using ASPEN-PLUS software.

In this simulation work we have studied how feed flow rate is affect the steady state behavior of CSTR.

It also gives optimum feed flow rate for the maximum conversion and yield with the consideration of the reactions which are in continuous manner where one of the product is desired another is undesired.

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