

300000 tons/year glycol production process preliminary design

Abstract

The glycol is an important basic organic raw materials of petrochemical, mainly for the production of polyester fiber, unsaturated polyester resins, antifreeze, etc... The present, the methods of industrial production of the domestic ethylene glycol is ethylene oxide legitimate direct water.

China currently has a size ranging from EO / EG set 11 sets, but compared to similar devices in the foreign and backward technology of these devices, energy and water consumption are higher, so the researchers EO / EG process optimization to reduce production costs, a very real sense.

This design is for the shortcomings of the ethylene glycol process, using the new reactive distillation process. the use of chemical process simulation software ASPEN PLUS process simulation and optimization, and finally get to meet product standards and to meet the design task results. Of major equipment selection, draw the diagram of the PID process.

Key words: ethylene oxide; glycol; reactive distillation; ASPEN PLUS; EO / EG

The thesis is divided into six chapters:

1. General
2. Process simulation
3. Material balance and energy balance
4. The design of devices
5. The innovation of this design
6. The protection of environment

Chapter 1

In the first chapter, describing something like the physical property of glycol, the use of glycol, the production status of glycol, a brief introduction of how to produce glycol also. About how to produce glycol, there are several kinds of methods, mainly divide into two parts: oil and coal. I finally choose using oil produce glycol, there are two reasons: 1, the process of using coal produce glycol is too complicated, in addition, presently, scientist can't find an efficient catalyst for this process, so the yield and the quality of ethylene glycol, to some extent, can't meet the requirement. Because of these facts, as a result, I decide to use oil as the material for producing glycol.

With the help of tutor, I plan using Reactive Distillation to produce ethylene glycol, the reason why I use Reactive Distillation producing glycol is that:

firstly, the process by using reactive distillation is quite simple than the common, otherwise, the most important thing is by using reactive distillation don't need catalyst; then, in Reactive Distillation, react and distillate occur at the same time, it a save of time and cost.

Chapter 2

In this chapter, mainly talking about the process of this design. there are three steps to produce ethylene glycol, first raw material EO(ethylene oxide) and water go inside of reactive Distillation column, after EO react with water, we can get ethylene glycol in reactive distillation; next step is to transfer ethylene glycol to the next distillation which is use to remove the water in the mixture.(because besides ethylene glycol, other product are water and diethyl glycol, and water count a big part in the mixture. Cause we just want to get ethylene glycol, so we should get rid of water and diethyl glycol, because water lighter than ethylene glycol and diethyl glycol, so we should remove water first). Finally, we should get rid of diethyl glycol from ethylene glycol and then we get the expected quality of ethylene glycol.

Chapter 3

In this chapter, I use aspen plus (a very popular program in simulating, especially in Chemical Engineering field, Aspen plus was created by professors who work at MIT), simulate this process, From raw materials to the end product. It's not quite easy to handle it, many parameters needed for this process, for example, the pressure and temperature of reactive distillation, which kind of property method can be used for this process, etc... after enter all the parameters and information, running it, and then, Aspen plus will calculate the result itself, finally, it will show all the result needed on the screen. If the result is not quite good, not meet expected target, there are also many functions in this program that can be used to optimize the process to get the ideal result.

Chapter 4

In this chapter, the main task is to figure out Material balance and energy balance, cause I use aspen plus this program, after enter all parameters and running Aspen plus, Material balance and energy balance can also be worked out by aspen plus, so that I don't need to work it out by hand. (Material balance and energy balance means material input into reactive distillation are equal to the product, no matter in quantity or in kind, so does energy).

Chapter 5

In this chapter, the main task is to figure out and build a reactive distillation virtually. To some extent, it is a little abstract and complicated, but I already have figure out how many water and ethylene oxide should put into reactive distillation, those parameter can help me to build column, and cause I use aspen plus, though this program also can offer some data, for instance, the height of reactive distillation, diameter, something like that. So with these data, I can figure out a reactive

distillation.

Chapter 6

In this chapter, describing the innovation of this design, for instance, commonly, most chemical factory that producing ethylene glycol use traditional method. But for this design, I choose reactive distillation, there are several advantages by using reactive distillation than traditional method, I introduce that before, so I don't say it there. Then, I use aspen plus model this process from beginning to the end. These are the highlight of this design.

Chapter 7

In this chapter, the main task is to describe the protection of environment. Because during produce ethylene glycol, there are maybe some other exhaust gas, discard solution, which can pollute environment or even harm for human's health, so that, in this section, I find out some way to deal with those waste.

How I do it

About how do I do it, before I went to Finland, I had participated in a competition which was organized by chemical association in China. This competition is for all college students in China. So I as the team leader team work other four classmates joined in this competition, it took 4 month from April to August. The topic of this competition is producing ethylene glycol, we choose the method and the condition, yield also. So before I went to Finland I ask my tutor whether I can use the result of this competition as my final thesis, my tutor said that I can, but I have to modify some place. So what I do is that.

I did my thesis in Finland, but I wrote it in Chinese and with the help of my Chinese tutor. When I met some problem or something I was not sure, I would ask her by internet. At 13th of June, all the students in our college have to answer teacher's questions, so that we can graduate, if we are fail to answer that question, we will do it next year. So I was back to China early to prepare it, because I study Paper Technology in Finland, and study Chemical Engineering in China, and my thesis is all about Chemical Engineering. So after this year's study, I almost forget everything about Chemical Engineering. Besides thesis, drawing is another thing we have to do, I draw 4 picture using AutoCAD.

The result

On 13th of June, it was the time for our teacher to check our thesis. At first, every should went to and stood on the platform and to shortly talked about their thesis, and there were three teachers sat in front of the speaker, teacher checked the instruction and printed CAD draw, to check is there anything wrong, while the one who talked about its thesis. When it's my turn, one of those three teachers checked my drawing and found a mistake that one of those four CAD drawing named wrongly. About 8 minutes later, I finished my description, teachers began to ask some questions about my thesis, and then, I make it, and finally I got 86 for my thesis,

although it's not quite high, but for me, it's pleased me, I think it's enough for me, cause I spend less time on my thesis than other students, they maybe spend near ten month on it, but for me(in China, we don't have any courses during forth year, just have one month internship to factory or company, so the rest of time will all be put on thesis) , cause I have to take class, and I also participated in several kind of projects in Finland, like Mindtrek Openmind 2015, Insight 2016, Kasvuopen_talent 2016. In the end, I accomplished totally 63 ECTS in TAMK. So I have less time left, about 2 month in total. And finally I got 86, I'm so happy to accept it.

Self-evaluation

To be honest, I get a lot by doing this thesis, for example:

1, Doing this thesis, I have to use some software, for instance, AutoCAD-using for drawing the model of factory and reactive distillation; Aspen plus-using for simulating the whole process, and optimize process. So I have to learn these software before, I spend about 3 months to learn Aspen plus, it's very hard to learn for a newb, to make matter worse, this program is in English, so it spend more time on it than AutoCAD. At first I almost spend two months on reading instruction and some related books, after learned the basic knowledge of Aspen plus, next month I put what I learned into practice. But sometimes I will meet some problems that I don't know why it occur and don't know how to deal with it, but luckily, there are some teachers who have taught me and still keep in touch with me, so if there are some problem I can't solve by myself, I will ask them to do me a favor. And now, I'm not sure I can use this program as easy as those teachers, but I, at the very least, I know how to form a process and how to running it, how to get useful data from this program. And then AutoCAD, same with the experience of studying Aspen plus, at first, watching some videos and books to know the basic knowledge of AutoCAD, and then practice.

2, it's a good chance for all the students to put what we have learned during these four years into practice, because, yes, here I want to say something different between Chinese student and Finnish student. As we all know, China is a big country with huge amount of population, so Chinese students is also play an important part in the whole amount of population. This is the background, when I was in Finland, with time gone, I knew some Finnish student, we often took class, talked and did experiment together, as a result, I knew some Finnish culture and how Finnish behave. The most different thing about student is that most of students in Finland, they will find a job instead of stay at home enjoying the whole summer or winter vacation when holiday came. Some of them even work during study day. Which surprise me a lot, cause in China, for moist of students, they spend their holiday by stay at home do things they like, for example playing games or watch Korean video, or travel to some beautiful place they dream for go there for a long time. That what our Chinese students doing. But there are also a small part of student, who find a job to earn some money. But it's rare, I also remember when I finished my study in Finland, I wanted to find a summer job in Finland, I also applied some companies, but seldom of those companies replied me, because they wanted some employees who

had one to two year experience in this field, although there were also other reason they don't accept me, like, for most of companies, candidate have to speak Finnish. But from this I realize that to some extent, Chinese students put a lot time on study, on theoretical knowledge. And looking down on practice, but for company, they want employee they know how to make process run, don't need some who just know theoretical knowledge. So that I think it's a good chance for us to put we learn into practice.

3, before I do this thesis, I search many references, and then screen some useful information. So I think I improve some of my ability.

What could have been done different

Because I don't have much time to spend on thesis, so if I have more time, there is one thing can be done better, I just used Aspen plus simulate the whole process, but I didn't pay more attention on optimize the process, although I have done something optimization, but it's too little.

What I'm happy about

By doing this thesis, I know how to produce chemical from raw materials to end product, and how to choose equipment, also parameter. That's what I'm happy about.