

# Research on the Teaching Reform of Chemical Engineering Design in Application-oriented University under the Background of Emerging Engineering Education Construction

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**Abstract:** *Chemical Engineering Design is one of the core curriculums to cultivate the innovation and engineering ability of college students. Through the study of this course, students can be familiar with the principles, methods, contents and procedures of chemical engineering design, acquire the basic knowledge and methods of chemical engineering design systematically, and be familiar with the compilation of design documents. It is an important curriculum to improve comprehensive quality of college student. Chemical Engineering Design is an important teaching link to convert the college students into engineer. To cultivate students' ability to analyze and solve practical engineering problems with the knowledge they have acquired, to cultivate students' correct design ideas and realistic spirit, and to be responsible for the coordination and innovation of their work style, to enhance students' engineering concepts, engineering thinking and technical and economic awareness, so that students have the basic quality of chemical engineer. Methods of teaching reform are discussed in this paper, from the aspects of increase practical teaching courses, the application of computers and chemical engineering design software, in order to abutment the requirement of enterprise and industry under the background of Emerging Engineering Education construction in application-oriented university and dissolve the problems in Chemical Engineering Design teaching.*

**Keywords:** *teaching reform, chemical engineering design, Emerging Engineering Education, application-oriented university*

## 1. Introduction

### 1.1 Background of teaching reform in chemical engineering design course

The construction of Emerging Engineering Education is a major action plan to continuously deepen the reform of engineering education based on the "excellent engineer education and training plan" (hereinafter referred to as "excellent plan") to meet the challenges of the new economy, serve the national strategy, meet industrial needs and face future development <sup>[1]</sup>. As a teacher of engineering major in Application-oriented Undergraduate Colleges and Universities, we should fully grasp the connotation of the construction of Emerging Engineering Education subjects, fully implement the "new requirements of Engineering", explore and establish new ideas, new standards, new models, new methods and new technologies of curriculum teaching. Teachers should carefully study the characteristics of the curriculum and start with the most fundamental curriculum teaching content and teaching methods in order to adapt and meet the requirements of talent training in Application-oriented Colleges and Universities under the background of new engineering construction.

### 1.2 Characteristics of chemical engineering design

Chemical process design is one of the core courses to cultivate students' engineering ability and innovation ability. It is one of the compulsory courses for chemical engineering majors. It is a discipline that integrates the knowledge of chemical technology, chemical principle, chemical equipment, chemical thermodynamics, reaction engineering, separation engineering and other professional courses and can reflect students' comprehensive professional ability <sup>[2]</sup>. Through the study of the course, students will be familiar with the principles, methods, contents and procedures of chemical design, systematically obtain the basic knowledge and methods of chemical design, and be

familiar with the preparation of design documents<sup>[3]</sup>. This course aims to cultivate students' ability to analyze and solve practical engineering problems by comprehensively using their learned knowledge, cultivate students' correct design thought and realistic spirit, rigorous, responsible, coordinated and innovative work style, enhance students' engineering concept, engineering thinking and technical and economic awareness, and enable students to have the basic quality of chemical engineers. It is a very important teaching link for college students to transform into engineers. The biggest feature of chemical process design course is the need to transition from pure theory learning to engineering learning in the lower grade. The cultivation of engineering ability needs a lot of practice. Through practical links such as computer learning, curriculum design and graduation design, students can skillfully use their mastered theoretical knowledge to solve practical engineering problems.

### ***1.3 Problems in our teaching of chemical engineering design***

At present, the first-class chemical design institutes have gradually adopted information technologies such as process integration, process optimization, online database, 3D CAD, project cooperation management, electronic document exchange and so on. Chemical engineering design has become an applied course integrating chemical technology, computer technology, engineering design and other knowledge, highlighting the cultivation of modern engineering design ability. For modern chemical design, computer is indispensable for predicting molecular structure, material properties, process flow design, equipment selection calculation and pipeline layout design<sup>[4]</sup>. The practice links of chemical design courses in some first-class universities are also using the current general chemical design software, and sufficient computer practice hours are set, such as Tianjin University and Zhejiang University. The chemical design courses of Professor Wu Jia of Zhejiang University are our examples in terms of course content, teaching means, course group, teaching level and professional ability. In the practice of chemical design, the inefficient and backward methods such as looking up manuals, looking at charts and formulas cannot meet the needs of employment. The teaching reform of chemical engineering design is imperative.

Through years of teaching practice and the performance of teachers and students in chemical design competition and chemical experiment competition, some problems in the teaching of chemical process design have also been found, such as backward teaching methods, improvement of teaching means, renewal of teachers' teaching ideas, strengthening of teaching ability, etc. Although teachers have made great efforts to make changes in the teaching process, such as paying attention to the combination of design examples and theories, designing teaching plans from the perspective of practical engineering design, case analysis and design example exercises are to improve the teaching quality. However, there are still some problems, such as less practice class hours and no computer practice time.

## **2. Research content**

### ***2.1 Optimize the practical teaching links of chemical engineering design***

"Chemical process design" is a pure theoretical course, which is taught by teachers according to the class hours of the theoretical course. There are many theories, and there is no computer class. Only some design regulations, general rules, theories and methods can be taught, making engineering practice a mere formality. How to improve students' engineering ability is a problem to be solved. After learning the course of chemical process design, students should have in-depth understanding and certain application skills of chemical design software, be able to apply chemical design software to curriculum design and graduation design. And truly cultivate students' ability to work independently, think independently and use their knowledge to solve engineering and technical problems, so as to meet the needs of industry enterprises.

### ***2.2 Apply chemical design software to course teaching***

Applying the latest chemical design software for teaching and course practice is the most basic and important teaching requirement for chemical design course. Many colleges and universities have made practical exploration and accumulated quite rich experience<sup>[5-7]</sup>.

The construction of chemical design software laboratory is not overnight, which requires human, material and financial resources. At this stage, to really apply chemical design software to course teaching, the most basic non-commercial process simulation design software, such as Aspen plus and

ChemCAD, can be installed on the existing simulation laboratory computer. The construction time of simulation laboratory is short, and the configuration of computer software and hardware can meet the operation needs of chemical design software, carry out field teaching, students practice on the computer, and be used in curriculum design and graduation design. Students are encouraged to participate in chemical design competitions, and teachers constantly improve their application ability of chemical design software, form a strong curriculum learning atmosphere, and cultivate application-oriented talents to meet the needs of industrial enterprises. Aiming at the problems of less class hours in the practical teaching of chemical process design, the low proportion of computer application in the practical teaching of chemical design, and the less contact of students with chemical design software, the teaching reform is carried out.

### ***2.3 Improve the professional ability of teachers***

Chemical process design is very practical and highly integrated with theory and practice, which requires teachers to be familiar with relevant professional courses and the production process of chemical enterprises, as well as chemical principles, chemical production equipment, chemical instrument automation, separation engineering, reaction engineering and other courses; He has very in-depth learning and use experience in various drawing software, data calculation software and process simulation process design software of chemical design, which requires teachers to keep pace with the times and make continuous learning and progress in order to improve their professional ability and meet the quality of "double qualified" teachers.

## **3. Research program**

### ***3.1 Increase the hours of practical teaching***

#### ***3.1.1 Add computer training***

The class hours of chemical process design are 32 class hours of pure theory course. During the teaching process, teachers talk according to the class hours of theory course. There are many theories, and there is no computer class. They can only teach some design regulations, general principles, theories and methods, making engineering practice a mere formality. How to improve students' engineering ability is a problem to be solved. Many colleges and universities have carried out some reform discussions in this regard. For example, when Professor Wu Jia of Zhejiang University taught the course of chemical design, the average theoretical course of 1 class hour corresponds to 2 class hours of computer training, which is used for the study of chemical design software and design cases, so as to promote the improvement of students' learning interest and engineering ability, and achieved good learning results.

#### ***3.1.2 Change the form of curriculum design of chemical engineering design***

The current curriculum design has only 16 class hours, which is short. The main problem is that the use of design software is insufficient or not. Due to the lack of software use conditions and class hours of curriculum content, students can only be organized to conduct preliminary design of chemical projects and be familiar with the rules, contents, principles and steps of chemical design, Modern chemical design mainly uses chemical design software for design, so that students can understand the use of the most advanced design software for chemical design, so as to lay a foundation for engineering design after graduation.

#### ***3.1.3 Promoting teaching through competition***

Encourage students to participate in the national chemical engineering design competition for college students (CEDC) and provide a platform for teachers to exchange professional knowledge and teaching methods. Students can improve their professional knowledge application level and engineering awareness through the preparation and defense of the design content of the competition, which is of great practical significance to cultivate their team cooperation spirit and innovation consciousness, The practice of many colleges and universities has proved that promoting teaching and learning through competition is an effective way to improve students' engineering practice ability<sup>[8-10]</sup>.

### **3.2. Increase the application of computer in chemical engineering design course**

#### **3.2.1 Chemical engineering design software and its application in our teaching**

The application of computer in chemical design can be simply summarized into three types<sup>[11]</sup>: One is design drawing, for example, the common flow chart drawing software is AutoCAD and VMGSim. Special software must be used to draw the flow chart of pipeline and instrument, such as PEDS 3D piping engineering design system. The PDSOFT 3D factory design software has the function of drawing the P&I flow chart. The software PIDCAD is specially used for drawing the process flow chart. The other is process simulation and design software, such as AspenPlus, Pro / II, HYSYS, ChemCAD, SuperProDesigner, etc. Then there is data calculation. Commonly used are MATLAB, visual basic, and AspenPlus for material balance and heat balance. The drawing includes the drawing of process flow diagram, equipment process and equipment diagram, equipment layout, workshop layout, pipeline layout, etc. Process simulation is mainly to estimate physical properties and optimize process flow. Data calculation includes material balance, energy balance and economic accounting. Chemical design software has been integrated into the course of chemical design in many excellent universities in China, such as Zhejiang University, Tianjin University, etc. Connecting with enterprises and learning from excellent colleges and universities, we should strengthen the proportion of computer application in chemical process design teaching.

#### **3.2.2 What should we do**

The teaching reform measures of the above courses put forward high requirements for teachers' computer application ability and professional level. In order to improve teachers' professional ability, teachers should be encouraged to study in this field. Software supply enterprises will organize corresponding training courses every year to improve teachers' use level and professional ability of chemical design software, such as Aspen Plus and chemical process simulation courses, which is very important to the teaching effect of the course. At the same time, appropriate theoretical classes should be arranged to introduce relevant software, so as to stimulate students' interest in software application. The problem in the process of computer learning is the separation of computer knowledge and professional knowledge, which is difficult to be applied in professional practice, but it can not meet the specified basic requirements in professional curriculum design. In addition, in the teaching of theory course, there is little or no computer training due to the course design and examination methods. How to better train students without increasing class hours and continuously improve the level of computer application is not only a problem that chemical design, but also a problem that other courses must face. In addition, it is also one of the trends of curriculum reform to reform computer teaching objectives and teaching plans in the learning stage of basic courses, combine with majors and strengthen discipline penetration. In terms of courses, computer-aided chemical engineering design courses can be set up, such as "the application of MATLAB in Chemical Engineering" and other practical teaching courses. The integration of mathematical theory teaching with computer practical teaching, chemical engineering professional course design, graduation design and other practical teaching can not only help to improve the level of chemical engineering design, but also help students learn chemical thermodynamics and course design Chemical engineering principles and course design, reaction engineering, separation engineering, chemical system engineering and other courses all play a positive role<sup>[12]</sup>.

## **4. Conclusion**

It is hoped that through teaching reform, the proportion of practical teaching in chemical process design teaching will be further improved, so that students can learn to use the most advanced design software for chemical design, fully meet the needs of industry enterprises, meet the requirements of the "excellent engineer education and training plan", and improve the teaching ability and professional level of teachers to meet the requirements of "double qualified" teachers, Lay a foundation for students to engage in engineering design after graduation.

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