On Study of Teaching Reform of Organic Chemistry Course in Applied Chemical Industry Technology

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Abstract: with the implementation of new curriculum reform, the education sees great changes in teaching methods. Teaching reform is profound in organic chemistry course in applied chemical industry technology. However, many problems which have never been noticed before occur when reform programs are implemented which harm students' ability for learning and enthusiasm in side face. This paper proposes reform measures like combining theory and practice, improving professional quality, supplementing professional needs and integrating teaching into life after analyzing organic chemistry course teaching in applied chemical industry technology currently, hoping to play a role of reference for organic chemistry course teaching reform in applied chemical industry technology.

1. Introduction

The organic chemistry course is set in second grade in applied chemical industry technology, and it is also a stage where a solid theoretical foundation shall be laid for students engaged in chemistry related occupations. Students are able to better learn follow-up professional courses after mastering theoretical knowledge and strengthening practical ability. The reform of organic chemistry course mainly aims at students' practical ability, applying knowledge into specific experiments and introducing life examples in teaching to make students better digest what they have learned rather than emphasizing theoretical knowledge in textbooks, and only by this way can teaching quality of organic chemistry courses be improved and teaching indicators in highly efficient classroom be achieved. This paper mainly emphasizes learning analysis and problem-solving ability of students and assists students in solving practical problems in chemical production effectively to equip students with theories and practice for chemical related occupations in the future.

2. Teaching Status Quo of Organic Chemistry Courses

2.1 Textbooks of Organic Chemistry Course

In terms of teaching in applied chemical industry technology in China currently, teaching ways are many in courses and there are more textbooks about organic chemistry which are usually written in Chinese or English bought by students. The preparation of these textbook is targeted, vary from fields and knowledge level, and are distinctive from others, allowing readers to choose according to their preferences. However, the content of these textbooks, based on basic knowledge, centers on compounds and classical organic chemical reactions classified by organic functional groups, structures and characterization methods of organic compound and life organic molecular compounds. While what is important in learning organic chemistry is the classic organic chemical reaction. Therefore, a key in complication is Chinese names of organic compounds in textbooks, and organic chemistry content is roughly the same which focuses on organic functional groups.
In the learning of organic chemistry, knowledge theories are of great abstraction, and involve compounds featuring wide ranges, complex structures and a large amount, so teachers have to focus on what kind of content is important. In former teaching, teachers tend to select textbooks with appropriate difficulty then they will increase or reduce knowledge in class according to teaching schedule. This teaching method is of great blindness, and fails to determine professional emphasis, making it difficult for teachers to give all key knowledge in limited time [1].

2.2 Teaching Methods of Teachers
The year 1990 saw the proposal of reform ideas of organic chemistry, and professional teachers have been dedicated to promoting reform of this course, while one problem in reform is that teaching methods are limited by traditional ideas. Therefore, it is necessary for teachers under this context to learn developed teaching models at abroad in order to reform current teaching methods. Modern thinking should be integrated into the teaching methods in order to make students better understand knowledge about chemical problems in teaching. What shall not be ignored is that although great achievement is made through this teaching method, it is still in a shallow level and fails to effectively combine traditional teaching methods with modern teaching methods. With the passage of time, the course teaching tends to be information-oriented and various teaching media facilities determine teaching quality, and knowledge related to writing, image and video is presented in the form of media, significantly facilitating teaching information; as theoretical knowledge involve in a wide fields, resulting in an embarrassing situation of "numerous classes, learning fall behind teaching". The "spoon-feeding" teaching method deprives students of subjective initiative, and students learn passively, while teachers play a dominate role, making students uninterested in learning.

2.3 Learning Situations of Students
Since the implementation of new curriculum reform, modular teaching method becomes a mainstream in middle school chemistry teaching, which brings in contradiction of organic chemistry teaching in the past and later; there is fewer learning content than that in inorganic chemistry course, and some students totally have no idea to organic chemistry, so they feel it difficult in learning and different learning performance occurs. In university, students feel as loss for learning without a good professional knowledge as support, and the unclear teaching objectives and low knowledge acceptance result in a situation where teachers put efforts to teach and students are poor in understanding. Meanwhile, in China, there are answers behind the textbooks exercise, and homework assigned by teachers aims at whole students, causing some students to copy standard answers behind without reading questions or to "imitate" others' after they finish homework, which not only fails to reach teaching objectives, but also greatly weaken students' problem-solving ability [2]. Therefore, the organic chemistry course should be one which enables students to be self-confident and believe that they are capable of solving problems.

3. Teaching Reform of Organic Chemistry Course
3.1 Combination of Chemical Industry Production Process
A main goal of organic chemistry teaching is to make students understand the process of chemical industry production. As for this point, chemical industry production process can be introduced into teaching to allow students to initially understand compounds and relevant processes. It can also make students understand relationships between production structures and nature so that students are able to summarize chemical industry production process in learning and to conclude physical and chemical properties within. In the organic chemistry course, the effective geometric chemical industry production process grants students to form an intuitive picture in virtue of their learning and specific production process, which is conducive to helping students consolidate what they have learnt, clear learning objectives, strengthen learning ability, stimulate learning enthusiasm and cultivate a self-directed learning style. It can also improve the problem-solving ability of students and assists them in being competitive in the follow-up professional learning and relevant occupations engaged.
For instance, in the teaching of benzene and its homologues, it is necessary to explain to students that organic matter can be used as raw materials and products which are great important to chemical industry production, and then thoroughly teach the production process of purified terephthalic acid which is main raw material to produce polyester. The Terephthalic acid (TA) is made by p-xylene (PX) which uses Co-Mn-Br catalyst, and conducts liquid phase oxidation in acetic acid solvent. Currently, purified terephthalic acid mainly includes four patented technologies: Amoco, ICI, Eastman and Mitsui. Each process varies from others as a result of different reaction temperatures which also leads to differences in pressure, catalyst, water content and reactor forms. As they are shown in the table below:

Comparison of Reaction Conditions and Reactor Types of Different Oxidation Processes

| Process          | Mitsui | Amoco | ICI  | Eastman |
|------------------|--------|-------|------|---------|
| Temperature (℃)  | 185    | 191   | 201  | 160     |
| Pressure (MPa)   | 1.0    | 1.26  | 1.57 | 0.6     |
| Catalyst concentration | 1650ppm | 1150 ppm | 700 ppm | 2420 ppm |
| Catalyst ratio (mol/mol) | Co:Mn:Br=2:1:2.4 | Co:Mn:Br=1:2:1.5-2 | Co:Mn:Br=1:2:3 | Co:Mn:Br =15:1:12 |
| Feed solvent ratio (HAc: PX) | 5:1 | 3-3.3:1 | 4.5:1 | 10:1 |
| Stay time (min)  | 60     | 51    | 40   | 46      |
| Water content (%) | 8-10 | 10-13 | 15-20 | 3.3-5.5 |
| CTA crystal grain size (μm) | 70-100 | >100 | >100 | 40-60 |
| Reactor types    | Bubble reactor + dehydration tower | Double-paddle stirred tank | Three layers of paddle stir kettle | Bubble tower - dehydration tower |

Here teachers will emphasize that the production process of PTA includes: PX oxidation, CTA depressurization, evaporation and crystallization, separation and drying of coarse TA product and recovery of acetic acid solvent. Process simulation can be finished by virtue of design data provided by enterprises and commercial software in laboratory based on existing research results.

In terms of course selection, teachers should avoid content which requires highly to theories and low to practice, and strengthen content which is closely related to production, it is better if content involves life. For example, when introducing nitrogen-containing organic compounds, teachers can state that the molecule contains organic compounds of carbon-nitrogen bond. Sometimes, the molecule contains C-O-N compounds, such as nitrates and nitrites. They widely exist in nature and are very important compounds. Many organic nitrogen compounds boast of biological activity, such as alkaloids; while some are indispensable substances for life activities, such as amino acids; many drugs and dyes are also organic nitrogen compounds.

3.2 Maintenance Combining Chemical Industry Equipment

In chemical industry production, organic reaction products need to be supported by various equipment conditions. In specific teaching process, teachers should make problems clear by combining specific examples of maintaining chemical industry equipment in order to make students know about knowledge
about equipment corrosion, so students will re-reflect the process of corrosion reaction, how to reduce corrosion and to prevent corrosion and to find better anti-corrosion materials and related anti-corrosion technology by virtue of what they have learned, which is a main condition to prevent equipments from corrosion. This will mobilize students’ subjective initiative in learning and make them realize important safe operation of equipment.

For example, teachers should mainly explain chemical reaction of chemical equipment rather than complicated industrial operation like cracking of alkanes and dissociation. Chemical equipment is made by metal whose corrosion is divided into physical corrosion, chemical corrosion and electrochemical corrosion. Physical corrosion refers the destruction of pure physical effects caused generally by dissolution and infiltration; chemical corrosion refers destruction caused by a direct chemical action of metal and non-electrolyte, also known as pure oxidation and reduction reaction; Electrochemical corrosion refers destruction caused by electrochemical action of metal and electrolyte solution and in this action process, the anode losses electrons, cathode gets electrons and electron flows. At this moment, what students think in mind is the corrosion reaction, such as surface corrosion technology and electrochemical protection. The corrosion speed of commonly used Q235 steel in media like acid gas and salt spray ups to 0.5 ~ 1.0mm/a, and if anticorrosion and painting are done to these equipment regularly, the painting film will fall locally, producing electrochemistry corrosion and reducing equipments' life with a wide scope once problems occur. The best solution is to use corrosion-resistant steel, and at this time, teachers can ask students what kind of corrosion-resistant steel they know, and then summarize that low alloy steel like 16MnCu, 09MnCuPTi and others can be used as manufacturing materials for equipments.

For example, in the teaching of conjugated diene chemical property, although Lewis acid can improve regional selectivity and yield of Diels-Alder reaction, the equipment will be greatly corroded, and there will be a lot of liquid waste glowing. It is common for such contradictory problem in organic chemistry course, so how to solve it, teachers can assign this as students’ homework and ask them to go through materials to find solutions. The basic result is that: when catalyst is replaced by solid superacid, although it plays a role in preventing the equipment from corrosion, it is an extremely long time for reaction; the preparation process for making catalyst is complicated, but is easier than Lewis acid, and slight contradiction still exists. Therefore, the best way is to replace the catalyst with macroporous resin whose corrosion is relatively small, recyclable, free of solvent reaction, and able to protect the environment.

3.3 Combination of Environmental Protection Issues

Although organic compounds make tremendous contribution to China's chemical industry, most of them are toxic and harmful substances and in this aspect, teachers need to warn students to make prevention. In teaching of organic chemistry, it is necessary for teachers to make students understand harm of them by combining environmental protection and safety protection, and listing examples in life [3].

For example, when giving a lesson to ammonia, teachers can introduce the event caused by liquid ammonia tank explosion in Bozhou Fertilizer Plant, Fuyang District, Anhui Province in 1987 that the end socket of the tank flew 65 meters away, driving the tank with 770 pounds to rush forward, and which instantly destroyed the cab where a driver was squeezed to death and three people were killed; when teaching aromatics, teachers should introduce a workshop explosion in Jilin in 2005 which caused vast benzene, nitrobenzene and other substances to flow into the Songhua River, severely polluting Songhua River and water quality; when giving a lesson about the nitrogen organic compounds, teachers should introduce the isocyanurate leakage event in Bhopal United Carbide Insecticide Factory in capital of Madhya Pradesh, India in 1984 which caused nearly 2,500 residents to die due to inhalation of a large number of toxic gases, and more than 200,000 people were affected, becoming the No. 1 tragedy in industrial history all over the world.

4. Conclusions

The reform of organic chemistry course has become the focus in teaching of applied chemical industry
technology. The main goal aims at enabling students to combine theory with practice, and to master more basic skills. In teaching, teachers should combine the actual situations, effectively integrate social development into chemical industry from aspects like chemical production process, chemical equipment maintenance, environmental protection and security protection, and adopt practical examples to further explain in order to exercise students' analytical skills and to encourage them to learn independently; only by this way can students realize the importance of teaching reform of organic chemistry and improve learning ability.

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