

Research on the Professional Characteristics and Curriculum System of Resource Recycling Science and Engineering

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ABSTRACT: Through the analysis of relevant professional of domestic colleges and universities, on the basis of researching the demand for talent and industry characteristics in the field of resource recycling in Tianjin, tightly around the treatment and disposal of municipal sludge and electrical & electronic waste and their resource utilization, the authors have developed personnel training objectives, determined the professional characteristics and built significant curriculum system. Curriculum system, that is scientific and reasonable, can meet the current needs of the community, and has potential development capacity, will provide teaching information and reference for all other universities in this new professional construction.

KEYWORD: Resource Recycling Science and Engineering; Professional Characteristics; Curriculum System

1 INTRODUCTION

In order to meet the country's energy conservation, low-carbon economy and circular economy, and other strategic emerging industries urgent need for high-quality talent, the specialty of "resource recycling science and engineering" was established. 2010 onwards, the Ministry of Education has approved 20 universities to add this specialty including Nankai University, Northeastern University, Shandong University, Beijing University of Technology, Changchun University, Fujian Normal University, Shandong University of Technology and Tianjin University of Technology, etc. Currently, the relevant universities to building ideas, talent research objectives, curriculum and other aspects of culture settings of this new profession are still at an early stage of exploration. Because the profession is emerging interdisciplinary professional, the focus of the major universities is different in the professional construction and development direction.

In view of this, based on long experience in the specialty construction, on the basis of a lot of research and on the combination of the characteristics of the industry and Tianjin resource recycling industry, the authors have learned professional features of other universities and determined the personnel training objectives of characteristic specialty. In addition, the authors have set curriculum system around the core technical route of resource recycling and built a featured

significant curriculum system to provide a reference for all colleges and universities in the new professional disciplines and curriculum planning.

2 TRAINING OBJECTIVES AND PROFESSIONAL CHARACTERISTICS

2.1 *Training objectives*

Based on a "thick foundation, wide caliber, strong practice, heavy quality" personnel training for the principle, on the treatment and disposal of waste electrical and electronic for training objectives, the professional studies science, technology, engineering and policy closely related to renewable resources, utilization, protection of ecological environment, and brings up the technical ability to carry electronics, metallurgy, materials and environmental protection.

2.2 *Professional characteristics*

According to the university's characteristics, in close connection with the strategic development objectives of Tianjin and the local characteristics, particularly in Tianjin eco-city construction and development of low-carbon economy for the concept, the professional is oriented in two training directions including "electrical and electronic waste disposal and recycling use" and "urban sludge treatment and disposal and resource utilization".

3 CONSTRUCTING CURRICULUM SYSTEM

Whether a curriculum system is reasonable will be directly related to the quality of personnel training (Jia 2013, Yu 2012). The main design idea of this curriculum system is that the ability as a main line, equal emphasis on theory and practice, "knowledge, ability and quality" three elements through to the end.

Full account of disciplines and knowledge of the professionals, the curriculum was set closely around the treatment and disposal and resource utilization of "electrical and electronic waste recycling" and of "urban sludge". The curriculum system mainly consists of four modules: public base module, professional foundation module, specialized modules and concentrated practice teaching module.

3.1 Public base module

Such courses mainly lay the foundation for improving the basic quality of students and learning the professional foundation courses (Huang & Zhu 2009), which includes mathematics, physics, chemistry, electronics, engineering drawing, computer systems and other basic courses.

3.2 Thick foundation, wide caliber, building professional base module

The construction of specialized basic course, on the one hand, should reflect the thick foundation, wide caliber; on the other hand, should be combined with professional orientation and professional characteristics direction. Professional basic courses of the college setting include as below: introduction to resource recycling engineering, urban sewage treatment technology, fundamentals of mechanical design and manufacturing, introduction to industrial waste treatment and disposal, resource recycling technology and equipment. Setting these courses, will not only be conducive to laying the technical foundation, also reflects the professional characteristics.

3.3 Outstanding professional features, building specialized course modules

Specialized course mainly focuses on the municipal sludge treatment and disposal and resource utilization, processing technology and resource utilization of waste electrical and electronic products, resource utilization technology of waste electromechanical products, treatment and utilization of waste rubber and plastic products, etc. In particular, class hours of the first two courses are enlarged, which strives to cultivate specialty talent different from other domestic universities of similar

disciplines in order to enhance professional competence.

3.4 Concentrated practice teaching module

This professional belongs to engineering majors. Therefore, practicality is very strong. In order to achieve the personnel training objectives of "strong practice, heavy quality", various concentrated practice teaching were set, as shown in Table 1.

Table 1. Statistical table of concentrated practice teaching

Practice teaching project	Semester inches	Weeks	Credit
Military training	3	3	2.0
Metalworking practice D	2	2	2.0
Electrical and electronic technology training	5	1	1.0
Course design	6	2	2.0
Cognitive internship	6	1	1.0
Professional design	7	6	6.0
Graduation design(thesis)	8	18	18.0

According to the training objectives and professional characteristics, the proportion of each module occupies credits vary throughout the curriculum system, specifically as shown in Table 2.

Table 2. Credit proportion of various courses

Course category	Obligatory course	Elective course	Total /proportion
Public basic courses	77.0	8.0	85.0/45.1%
Professional basic courses	47.5	0.0	47.5/25.2%
Professional courses	10.0	12.0	22.0/11.7%
Concentrated practice teaching module	34.0	0.0	33.0/18.0%
Total/proportion	168.5 /89.4%	20.0 /10.6%	188.5/100.00%

Curriculum system is a more complex issue, and is the problem of a dynamic development (Wang & Fan 2011, Peng 2013, Wu 2010). Positioning of different universities, teaching content requirements is different. And then, the class hour proportion is different among the public basic course, professional basic course and specialized courses. In this study, curricular total hours are set to 2472 class hours, of which the proportion of obligatory and elective courses is 6.7:1. Curricular compulsory part is 2152 class hours (Table 3).

Table 3. Allocated proportion of curricular teaching class hours

Course category	Obligatory course	Elective course	Total /proportion
Public basic courses	1232.0	128.0	1360.0/55.0%
Professional basic courses	760.0	0.0	760.0/30.7%
Professional courses	160.0	192.0	352.0/14.2%
Total/proportion	2152.0 /85.9%	320.0 /12.9%	2472.0/100.00%

In the stage of professional foundation courses and professional courses, theoretical and practical teaching combination is adopted for personnel training. Class hour proportions are as shown in Table 4.

Table 4. Class hour proportions on theoretical and practical teaching

Category	Obligatory course	Elective course	Total /proportion
Theoretical teaching	1818.0	320.0	2138.0 /73.4%
Practical teaching	Experiment:187.0 Computer:30.0 Centralized practice :544.0 Subtotal:761.0	Experiment :16.0	771.0 /26.6%
Total /proportion	2579.0 /88.5%	336.0 /11.5%	2579.0 /100.00%

4 IMPLEMENTATION OF CHARACTERISTIC CURRICULUM SYSTEM

4.1 Strengthening the "research" cooperation

The institute has been reached to build a "research" base agreement with China Electric Apparatus Research Institute and Tianjin Ziya circular economy industrial zone. Based on the goal of waste sludge recycling and reuse in urban ecosystem resources to develop the mode of operation of personnel training mechanism of universities-enterprise, the authors propose jointly the management model of two "research" bases in "municipal sludge treatment and disposal" and "universities-enterprise electronic resource utilization", which will provide a good basis for personnel training and professional development.

4.2 Strengthening laboratory construction

In the "thick foundation, wide caliber, strong practice, heavy quality" personnel training purposes, the professional attaches importance to the cultivation of professional skills to improve students' innovative ability and practical ability. The authors

take "have for, have not for" approach to establish an effective investment mechanism and strengthen laboratory construction. In addition, the authors actively explore the establishment of a "people-oriented" laboratory management system, open specialized laboratories to improve the efficiency of the laboratory.

5 CONCLUSIONS

This study has established training objectives and professional characteristics closely around disposal and resource utilization of "urban sludge" and "electrical and electronic waste", also constructed curriculum system with strong professional characteristics.

Training programs and curriculum system developed in this study can be used as the sharing platform for teaching resources and academic resource, which will be widely promoted to construction of new professional of various universities, and further provide education information and reference.

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REFERENCES

- [1] Huang, Z.Y. & Zhu, Y.H. 2009. Curriculum system construction and professional characteristics concise of project management. *Journal of Chongqing University of Science and Technology*: 205-206.
- [2] Jia, Y.F. 2013. Reform and Exploration on the construction of characteristic specialty and the curriculum system in universities. *Journal of Changchun University of Science and Technology* 26(7): 182-183.
- [3] Peng, Y.Y. 2013. Research on the reform of curriculum system and optimization & integration of teaching content in Applied Physics. *Education Teaching Forum* (50): 40-41.
- [4] Wu, L.X. 2010. Research on the characteristics curriculum system of electronic information science and technology. *Contemporary Educational Theory and Practice* 2(1):105-107.

[5] Wang, J. & Fan, L.P. 2011. Study and Practice on the specialty construction of Electronic Science and Technology. *China Electric Power Education* (20): 56-57.

[6] Yu, H.Z. 2012. Research on professional characteristics and core curriculum for material forming and control engineering. *China Electric Power Education*: 34-35.