Improvement of Industrial Hazardous Waste Management

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Keywords: Industrial hazardous waste, Improvement, Management.

Abstract. Industrial Hazardous Waste Management is a special bilingual course offered to students whose major is Environmental Engineering. Through learning of this course, the students should know the basic information the industrial waste engineer needs to know about the environmental impact of various wastes, theories and designs of waste treatment, and shows how waste can be reduced through proper operation of manufacturing plants, and concise evaluations of all major liquid Industrial wastes, including their origins, characteristics, and acceptable treatments. This paper first analyzes the characteristics and probes the problems of this course prior to construction. Then it proposes a developing plan for the course: description of teaching contents prior to construction, aim for this class and construction, improvement of teaching methods and modes, and etc.

Introduction

The global is witness serious pollution of air, which causes lots of diseases including respiratory disease, throat pain and lung cancers due to development of industry and urbanization. It was estimated that about half of the global population now lives in cities and it is increasing [1, 2]. Urbanization results in seriousness of air pollution as people live in environments that are generally more polluted and less green [3]. Urban pollution results in not only increase of mortality and morbidity in adults and children but also adversely affect body development [4]. It was proved that maternal exposure to pollution has been associated with the risk of low birth weight, preterm birth, intrauterine growth retardation, and congenital anomalies [4]. Green plants have been reported to be beneficial to physical and mental health and well-being [5], e.g. beneficial effects on pregnancy outcomes. In addition, it was reported that higher surrounding greenness of maternal residential address was positively associated with an increase in birth weight [6].

Among those pollutions, hazardous waste pollution is especially harmful to both human health and the environment. Hazardous waste means a solid waste, or combination of solid wastes, which may cause an increase in mortality or an increase in serious irreversible illness or incapacitating reversible illness; or pose a substantial or potential hazard to human health or the environment when improperly stored, transported, treated, or disposed of, or otherwise managed [7]. The RCRA regulations specify that a solid waste is a hazardous waste if it is not excluded from regulation and meets any of the following conditions: exhibits any of the characteristics of a HW (ignitability, corrosivity, toxicity, reactivity); appears as a listed HW; is a mixture containing a listed HW and a nonhazardous waste; Is a waste derived from the treatment, storage, or disposal of a listed HW.

Hazardous waste pollution control needs qualified professionals, which is the aim of this course. The pollution Control Engineering aims to let students grasp basic theories for pollution control, pollution sources and control ways, processing methods and equipments. To cultivate graduates of inter-disciplinary talent with up to date hazardous waste control knowledge, this course needs improvement.

This paper first analyzes the characteristics and probes the problems of this course prior to construction. Then it proposes a developing plan for the course: description of teaching contents prior to construction, aim for this class and construction, improvement of teaching methods and modes, and etc.
Description of This Course Prior to Construction and Aims for Developing This Course

Description of This Course Prior to Construction

It is a major and special course of 32 class hours, which is offered to undergraduates in Environmental Engineering. Prior to construction, major contents involve the following four sections. Section one presents the basic formation the industrial generators need to know about the environmental impact of various wastes, such as statements for environmental impact, protection of streams, calculation of treatment processes, testing of the treatment efficiency, and the influence of economic factors on waste treatment. Section two explores theories and designs of waste treatment, and shows how waste can be reduced by proper management. Section three provides a novel paradigm for obtaining zero pollution through process control. Section four offers concise evaluations of major liquid industrial waste, including their origins, characteristics, and acceptable treatment. Six types of industrial hazardous waste generation sources are involved, including apparel, food processing, materials, chemicals, energy and non-point practices.

The Requirements of Construction of This Course

As one of the main special courses offered to undergraduate students majoring in Environmental Engineering, it plays an important role in environmental protection. Firstly, it requires improvement in software and hardware. Secondly, enrichment of teaching contents through consulting data in the field of water pollution control should be achieved. Thirdly, teaching methods and modes should be improved to make it attractive for easy understanding of the students. Fourthly, bilingual teaching is required in some parts of this course to improve use of English for cultivating competitive students. Fifthly, more experiments are required for students for better understanding of hazardous waste pollution control technologies. Sixthly, exercise database and test paper database should be compiled through construction. Through the construction process, it aims to improve teaching effect of this course, which is conducive to cultivating qualified students.

Construction of the Course


Teaching Method. Hazardous waste management is taught through multimedia, including ppt (power point) and CAI (Computing Aided Instruction). Multimedia refers to combination of a variety of media-text, graphics, sound, animations, video and other visual information to make up an application system. Multi involves multisensory function, multi-facilities and multi-field. It involves all aids that may be used by teachers and students to attain certain educational objective [5]. Ppt and CAI are two important ways of multimedia.

Ppt is used in multimedia teaching. To make it vivid, diagrams or pictures are used to describe some definitions or phenomenon. For example, the structure of a incinerator is clear in Fig. 1. A landfill involves the liner system, the final cover, leachate collection system and landfill gas collection system. Drainage ditch is used to discharge surface runoff from the landfill to prevent water percolation through the liners and thus reduce generation of leachate.
In addition, some experimental results are involved in teaching of this course. For example, MSWI (municipal solid waste incineration) fly ash is studied by XRD, SEM, IR, XRF, and EDS. Particles distribution of the ash is studied by SEM.

CAI is a good choice for teachers to make the class attractive. For example, pollution types and control ways can be easily understood using the CAI video. It is clear through the CAI, why the environmental problems are complicated and influence long and far-reaching, how the problems can be prevented and solved. CAI software used in the course include laws, regulations, and standards in China, solid waste pollution and control methods, air pollution and control, water pollution and control, noise pollution and control, sustainable development, cleaner production, ecological development, ecological agriculture, ecological cities, industrial ecological garden, recycling economy.

Performance of Experiments. The text book for experiments is Experiment for hazardous waste Pollution Control, written by Hao Jiming and Duanlei, published by Higher Education Publishing House in 2004. Experiments involved in pollution control involve measurement of concentration of TSP, \( \text{SO}_2 \), and \( \text{NO}_x \), monitoring of indoor pollution, detection of tail gas, measurement of fume flow and dust concentration, particle distribution analysis by crushing, particle distribution analysis by Kuerte, particle distribution analysis by ELPI, electrical resistance measurement of dust, on line detection of dust concentration, measurement of tail discharge, characterization of cyclone dust cleaner, characterization of baghouse, characterization of electro-precipitator, adsorption of sulphur dioxides by active carbon, absorption of sulphur dioxides by basic liquid, wet removal of sulphur by MgO, removal of sulphur through spraying of Ca.

Results of Bilingual Teaching in Hazardous Waste Management

Bilingual courses in Environmental Engineering are popular in students. Questionnaires were conducted among students choosing Hazardous Waste Management. The total number of students attending the course Hazardous Waste Management was 30 in 2013, 19 in 2014, and 31 in 2015. Analysis of the questionnaires on bilingual teaching of this course was shown in Table 1. Over 88% of students were in support of this course given in both English and Chinese and over 96% of them regard bilingual teaching is helpful for them. From 2014 to 2016, there is an increase of the number of students who are in support of bilingual teaching of this course. Consequently, some students who oppose bilingual teaching also think it is helpful for them, while some reasons, i.e. a bad grasp of English, prevent them to choose bilingual.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of students in support of this course given in bilingual language</th>
<th>Number of students against of this course given in bilingual language</th>
<th>Number of students that think both ok</th>
<th>Number of students that regard bilingual is helpful</th>
<th>Number of students that regard bilingual is not helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>25</td>
<td>2</td>
<td>3</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>2015</td>
<td>16</td>
<td>1</td>
<td>2</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>2016</td>
<td>27</td>
<td>2</td>
<td>2</td>
<td>31</td>
<td>0</td>
</tr>
</tbody>
</table>

To find out the effect of this course, questionnaires were conducted among students choosing this course on how much they understand this course. Analysis on extent of understanding of this course was shown in Table 2. It was shown that 60-84% can understand over 80% of the content taught in class, 13-37% of the student can understand 50-80% of the content, less than 4% can understand 20-50% of the content. To improve teaching results of the bilingual course, students who have a bad English proficiency are not encouraged to choose a bilingual course, while those with better understanding of English are encouraged to attend bilingual education to learn technological knowledge on the one hand and improve their English level on the other. Therefore, it was suggested that bilingual teaching be fulfilled in some selective course, not obligatory courses, so that the students can decide if they will choose a bilingual course based on their actual English level.
Table 2. Analysis on extent of understanding of the course.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of students that understand over 80% of the content</th>
<th>Number of students that understand 80-50% of the content</th>
<th>Number of students that understand 50-20% of the content</th>
<th>Number of students that understand no more than 20% of the content</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>18</td>
<td>11</td>
<td>1</td>
<td>0</td>
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<tr>
<td>2015</td>
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<td>4</td>
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</tr>
<tr>
<td>2016</td>
<td>26</td>
<td>4</td>
<td>1</td>
<td>0</td>
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</table>

Conclusions

As one of main courses offered to graduates Majoring in Environmental Engineering, this course aims to let student master the basic theory and major technologies used in hazardous waste pollution control, types of pollutants and sources, and prevention of the pollution. To improve the ability of applying knowledge to practical problems, experimental class is also offered, which is based on nowadays control methods.

Given development of hazardous waste control in China, the content of the course is enriched to six sections through the construction process. In addition, ten experiments are offered to students to ensure a better understanding of hazardous waste pollution control technologies and analysis. Ppt (power point) and CAI (computing aided instruction) are used in teaching, which improves teaching and learning effect of the course. Teaching and participating of students are both important for understanding of this course and improvement of the teaching effect.

Acknowledgements

We thank the construction of “Hazardous Waste Management” for supporting the developing project of this course under project number of 33210M161018.

References