

Construction of the course of Industrial Waste Management

CAO Ping

School of Chemical and Environmental Engineering,
Shanghai Institute of Technology
Shanghai, China
Email: cping@sit.edu.cn;

XIA Weihong

School of Chemical and Environmental Engineering,
Shanghai Institute of Technology
Shanghai, China 200235
Email: xiabing8515@126.com

Abstract— Economic development results in a rapid growth of solid wastes, which requires proper treatment. Therefore, there's a great need for professionals special in municipal solid waste treatment, which makes the course of Industrial Waste Management necessary for undergraduate students majoring in Environmental Engineering. This course is one of special courses offered to students whose major is Environmental Engineering. In order to keep up with industrial waste management nowadays, it is necessary to develop this course to make it up-to-date. Based on analysis of the current conditions of this course prior to construction, the paper offers a construction plan for the course in the following aspects.

Keywords—construction; industrial waste management; course

I INTRODUCTION

With the rapid development of economy and urbanization, industrial solid waste generation has seen a fast growth in recent years ^[1,2]. There is a call for sustainable in industrial design and waste management, which was inspired by the need to envelop awareness and solutions to the ongoing issues and concerns of waste generated from industry. The development of science and technology has increased human capacity to extract resources from nature and it is only recently that industries are being held accountable for the detrimental effects the waste they produce has on the environment ^[3]. To tackle problems caused by industrial waste pollution, increased governmental research, regulation and corporate accountability are digging up issues pertaining to pollution control and waste treatment and environmental protection ^[4]. The traditional approach for clinical waste, agricultural waste, industrial waste, and municipal waste, which are depleting our natural resources, should be improved.

Treatment, disposal and recycle of industrial waste have become more and more important. These wastes include inert compositions (glass bottles, excavated soil, building and demolition waste and etc.) and some hazardous parts. Pre-treatment (pulverizing, bale and separate collection) of industrial waste is performed for convenience of latter treatment. This process can reduce volume of the waste and improve the handling character. In addition, some useful compositions can be recycled through separate collection on the one hand and secondary pollution can be avoided ^[2]. All these are achieved through industrial waste management.

The main objective industrial waste management is to conserve the natural resources by approaching 100 % full utilization of all types of wastes by cradle-to-cradle concepts. Sustainable development and environmental protection can only be achieved with establishing the concept of industrial ecology ^[5]. The main tools necessary for establishing Industrial Ecology and sustainable development and the concept of 'industrial ecology' will help the industrial system to be managed and operated more or less like a natural ecosystem, and thus causing as less damage as possible to the surrounding environment ^[6,7].

This course targets undergraduate students, whose major is Environmental Engineering. Through learning of this course the students are required to grasp integrated approach for sustainable development including tools, methodology, and indicators for sustainable development. To keep up-to-date with current industrial waste management, this course needs construction.

This paper analyzes the current conditions of this course and aims for construction. In addition, a developing plan for the course construction was offered in the following aspects: adjustment of the course content, choosing of the textbook and reference books, improvement of teaching methods and class modes, preparation of test database and exercise database.

II CURRENT CONDITIONS AND AIMS OF DEVELOPING THIS COURSE

A. Course description prior to construction.

It is one of special courses offered to students whose major is Environmental Engineering or Environmental Science. Through leaning this course, the students should grasp the following knowledge: current practices in industrial waste management, cleaner production, industrial ecology, sustainable development and environmental protection, treatment and disposal of construction and demolition wastes and clinical solid waste.

B. Aims for development of this course.

China is witness a fast increase of industrial waste generation due to economic development. The increasing generation of industrial waste requires proper treatment prior to final disposal. Therefore, the course should be constructed

to keep up with development of current industrial waste management and cultivate students qualified for industrial waste control. The teaching contents should be revised to make it more appropriate for students. PPT should be improved and CAI offered for better understanding. Test paper database exercise database should be prepared.

III CONSTRUCTION OF THE COURSE

A. *Adjustment of the content of environmental engineering.*

Before construction of this course, major contents of the course are divided into two parts. Part one, introduction to industrial waste Treatment; history of environmental industrial wastes; theories and practices; volume reduction; contaminant concentration reduction; neutralization; equalization and proportioning; suspended solids removal; colloidal solids removal; inorganic dissolved solids removal; organic solids removal; Treatment and disposal of sludge solids; joint treatment with domestic sewage; treatment of hazardous wastes; air contaminants removal; major industrial wastes. Part two, rational of environmental complexes; procedure for industry in attaining zero pollution; economics of environmental complexes; realistic industrial complexes; potential industrial complexes; potential municipal-industrial complexes; naturally-evolving industrial.

Given development of industrial waste management in China, the content of the theoretical class involves six chapters. Chapter 1, current practice, includes introduction, waste management, treatment, incineration, landfill, zero pollution. Chapter 2, cleaner production, involves introduction, promoting cleaner production, benefits of cleaner production, obstacles and solution of cleaner production, cleaner production techniques, methodology for cleaner production assessment, case Studies. Chapter 3, industrial ecology, involves introduction, industrial ecology, industrial ecology barriers, industrial ecology tools and indicators, cradle to cradle concept, eco-industrial parks, Kleinberg industrial farm. Chapter 4, sustainable development and environmental protection, includes introduction, sustainable development tools and methodology, environmental reform structure, sustainable development proposed framework, summary and conclusion. Chapter 5, Construction and demolition wastes, includes introduction, construction waste management, proposed guidelines for construction waste, proposed guidelines for demolition waste. Chapter 6, Clinical solid waste, involves introduction, management of clinical waste, disinfection of clinical wastes, current experience of clinical wastes, cradle to - cradle for clinical waste, electron beam technology, electron beam for sterilization of clinical wastes.

B. *Choosing of the textbook and reference books.*

The text book is Sustainable Industrial Design and Waste Management: Cradle-to-Cradle for Sustainable

Development, written by Salah El-Haggar, and published by Academic Press Inc in 2007. The book includes numerous case studies that allow the reader to adapt concepts according to personal interest/field. It reveals innovative technologies for the conservation of natural resources. It is the only book which provides an integrated approach for sustainable development including tools, methodology, and indicators for sustainable development.

Two reference books are recommended. One is Industrial Waste Treatment Handbook by Woodard & Curran Inc, published by Butterworth-Heinemann Ltd; 2nd Revised edition in 2006. This book provides the most reliable methodology for identifying which waste types are produced from particular industrial processes and how they can be treated. There is a thorough explanation of the fundamental mechanisms by which pollutants become dissolved or become suspended in water or air. The other reference book is Industrial Waste Treatment: Contemporary Practice and Vision for the Future by Nelson Leonard Nemerow, published by Butterworth-Heinemann Ltd. in 2006. This book provides the reader with the basis for a more effective method of waste treatment which is sustainable and supportive of industrial improvements. Overall, it provides valuable information for planners, industrial, civil and environmental engineers and government officials for a better understanding of current practices and regulatory history and how these factors relate to the ability to complete environmental solutions to industrial waste problems.

C. *Teaching method.*

Environmental Engineering 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. CAI courseware is one of modern interesting teaching methods. CAI is a good choice for teachers to make the class attractive. CAI used in this course includes Cleaner Production, Industrial Garden, Sustainable Development, Laws and Regulations, Waste Recycling, and act.

PPT is used in multimedia teaching. To make it vivid, diagrams and pictures are used to describe some definitions or phenomenon. For example, Fig. 1 describes structure of a landfill for industrial wastes, in which the cover systems (final cover, intermediate cover and daily cover), Life and liner systems (bottom liner and side liner) are clearly shown. It makes it easy for students to understand meaning the special words.

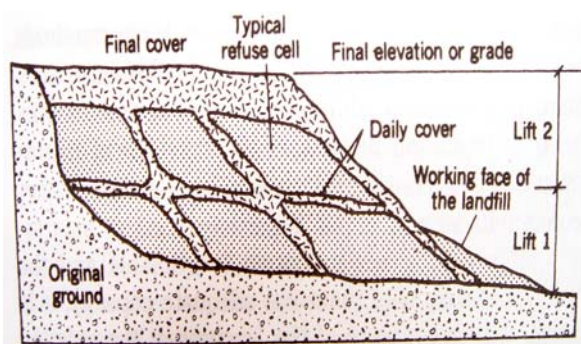


Fig. 1 Structure of a landfill

Monitoring of the incoming system includes direction, weighting, and load inspection, which are clear in Fig. 2. All these figures will be used to improve teaching effect of this course.

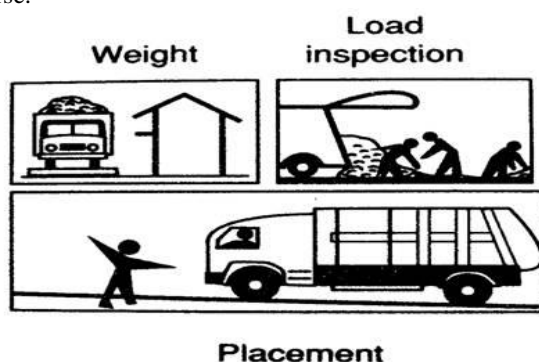


Fig. 2 Landfill operation

C. Class mode.

Class teaching is the most important mode for this course, which requires teachers present what should be taught clearly. Besides teaching, students are encouraged to participate in class teaching. Class discussion on some topics raised by teachers and personal presentation for several minutes are two important ways for students' participating, which are active learning and have better effects than passive learning. Discussion is a good way to enhance understanding of the course, which is flexible. The students are encouraged to say anything on the problems promoted for discussion. In addition, the students are required to make a short-term presentation, which is a good way to a deeper understanding on some subjects.

D. Test paper database and exercise database.

Through construction of this course, test paper database and exercise database will be compiled to check if the students grasp what is taught in the class. Both the test paper database and exercise database cover all contents of the

course. Exercise database involves true or false database, single and multiple choice databases, close database, definitions database, diagram explanation database, simple explanation database and computation database.

Test paper involves seven types of subjects, true or false, single choice, close, explanation of definition, answering questions, discussion of problems and computation. Discussion of problems is made based on videos watched in the class and questions prompted by teachers or students. Making choice is based on discussion in class and is much flexible. Close and single choice is based on basic knowledge that the students should remember.

E. Suggestions on improvement of teaching effect.

To improve teaching effect, the following aspects are quite important. Firstly, teaching content should be appropriate for students. Secondly, choosing an appropriate textbook is important for a better understanding of the course. Thirdly, improvement of the PPT and CAI software is an important guarantee for a good presentation of the course and a good understanding on what is taught for students. Fourthly, active participation of students should be encouraged, including discussion of topics and personal presentation.

IV. CONCLUSIONS

This course is offered to undergraduate students, whose major is Environmental Engineering. Class teaching and students' participation (including discussion and personal presentation), are two class modes. Through learning this course, the students should grasp general knowledge and common technologies used in industrial waste management.

Given development of industrial waste management in China, the content of this course was revised to six sections through the construction. In addition, experiments using some modern instruments were added to improve practical capacity of students in solving problems. Teaching methods involve multimedia, including PPT (power point) and CAI (computing aided instruction), and lab experiment. Teaching and participating of students are both important for understanding of this course and improvement of the teaching effect.

ACKNOWLEDGEMENTS

We thank the Leading Academic Discipline Project of Shanghai Municipal Education Commission under the project number J51502 for supporting the developing project of this course.

REFERENCES

- [1] J.G. Jiang: Solid Waste Treatment and Disposal, Chemical Engineering Publishing House, Beijing (2005).
- [2] S.E. Haggard: Sustainable Industrial Design and Waste Management: Cradle-to-Cradle for Sustainable Development, published by Academic Press Inc (2007).

- [3] Woodard & Curran Inc: Industrial Waste Treatment Handbook, published by Butterworth-Heinemann Ltd, 2nd Revised edition (2006).
- [4] N.L. Nemerow: Industrial Waste Treatment: Contemporary Practice and Vision for the Future by, published by Butterworth-Heinemann Ltd. (2006).
- [5] Y.C. Zhao: Solid Waste Incineration, Chemical Engineering Publishing House, Beijing (2006).
- [6] Y.T. Hung, H.H. Lo, and L.K. Wang: Handbook of Industrial and Hazardous Wastes Treatment, published by Marcel Dekker Inc, 2nd Revised edition (2004).
- [7] N.L. Nemerow and B.: Industrial Waste Treatment: Contemporary Practice and Vision for the Future, published by Butterworth-Heinemann Ltd (2006).