VIETNAM NATIONAL UNIVERSITY OF HOCHIMINH CITY

UNIVERSITY OF TECHNOLOGY

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LE ANH KIEN

SYSTEM ANALYSIS FOR SPECIFIC INDUSTRIAL SOLID WASTE COMBUSTION

Major: Chemical and Process Engineering

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Supervisor: 1. Asso. Prof. Dr Sc. LE XUAN HAI

2. Prof. V.N.SHARIFI

PhD THESIS

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1. INTRODUCTION

Saving fossil fuel, reducing solid waste, and renew energy from solid waste are taken into account around the world. Recycling of solid waste is becoming the manufacture in industrial nations such as UK, EU, USA, China, Japan,... This kind of manufacture supply the recycling material such as plastic, paper, wood, metal, glass,... in low cost.

The rest of recycling waste containing of organic compound is treated by incineration method. Combustion of "segregated waste" combining of producing power is playing the very important research field in the industrial nations. One of the popular incinerator using is the travelling bed.

The travelling bed incinerator use to combust biomass, solid waste in the industrial nations around the world. Many researches of the university, institution, and the company were taken place and this contributed the knowledge of the combustion theory, combustion efficiency,... Up till now, however, there is not any research carried out the combustion of segregated waste in the travelling bed inccinerator using the system analysis method. Therefore, the subject of the PhD thesis "System analysis of combustion for segregated waste" was performed in the combining programme between the Vietnam National University of Hochiminh City and the Sheffield university, UK.

2. OBJECTIVE

- Material: segregated waste and biomass;
- Equipment: packed bed (model of the travelling bed incinerator);
- Process: combustion of solid waste;

- Method: modelling of solid waste combustion;
- Programme: combustion simulation programme.

3. AIM

- Research on combustion process of mixture material in packed bed combuster;
- Determine the combustion kinetic equation for each type of materials;
- Building up the conservation equations basing on the system analysis method;
- Building up the simulation programme for combustion of solid waste using the finite volume method;

4. CONTENT

- Literature review of combustion process on solid waste around the world in birdview of system approach methodology.
- Study on the effect of physical factors inlet on combustion process, such as air supply, bed porosity.
- Using the system analysis on building up the conservation equations for travelling bed incinerator.
- Study on the experimental data to figure out the material properties; study on the combustion process for each type of material in the packed bed reactor to find out the model coefficients.
- Building up the CIS programme basing on the finite volume method to simulate and to verify the mathematical model.

5. METHOD

- System partition method: figure out the details to study on the sub-system.
- System integration method: integrate the results obtained on researching sub-system to apply on the upper system.
- Study on the object model: perform the experiment on the object model to find out the combustion process properties for each type of materials.
- Research on the mathematical model: to support research on the object model.

6. SCIENCE CONTRIBUTION

- This is the first research using the system analysis method to study combustion of segregated waste on the pot burner.
- Modelling of solid waste combustion in packed bed reactor basing on the population balance equation.
- Experimental work on the segregated waste contributed the knowledge of combustion science throughout recognising the combustion kinetic equations for each type of materials.
- Building up the control factors, such as ABR, SBR, IFS, IR, BR contributed combustion process in the packed bed reactor. This was also enhanced combustion research position of Vietnam in ASEAN by published the paper in the RSCE 2006 at the Singapore, The 21st conference of Chemical Engineering of Malaysia in 2007, ASEAN journal in 2008, Conference for 2nd ASEAN Chemical Engineering in 2009.

- Objects of study, such as mix paper, mix biomass contributed to the research of combustion group of the Sheffield University. This also contributed to the combustion study in Vietnam.

7. APPLICATION CONTRIBUTION

- The study of combustion process on packed bed reactor may be applied for the travelling bed incinerator combustor in many countries around the world, and the static two chambers in Vietnam. With the successful application of the system approach methodology using system analysis task to approach the combustion process, the method was applied into the research title "Research on combustion process to dispose the solid waste of Hochiminh City", and "Research on the pyrolysis process for the organic compound in municipal solid waste to produce fuel".
- The research object in the thesis was segregated waste. The results reduced the pressure of landfill, especially in combining of combustion and produce electricity.

8. CONCLUSION

1. Determining the proximate and ultimate properties and calorific value of material
2. Building up the equations to model the relatiion of proximate, ultimate and HHV for each type of material.
3. Establishing the combustion kinetic models for each type of material in air by means of activated energy exponential coefficient and reaction order from the results of thermal-gravimetric analysis.

4. Studying the combustion process of mix material in packed bed reactor under the birdview of system approach methodology.
5. Figuring out the control factor to respond the phenomenon of partial combustion, char combustion, effective of tar combustion.
6. Building up the mathematical model for slid waste combustion in the packed bed reactor.
7. Building up the simulation programme to pedict the solid fuel combustion in many applications.