สำนักงานวิทยทรัพยากร จุฬาลงกรณ์มหาวิทยาลัย

CHAPTER I

INTRODUCTION

1.1 Background

In adsorption process, gas and vapor are separated from mixed gas stream released from operation by adsorption onto the solid surface. The molecule or material which is adsorbed onto the adsorbent is called the adsorbate. The two mechanisms involved are physical adsorption, or physisorption, and chemical adsorption, or chemisorption. Both adsorption mechanisms are exothermic reaction. Physisorption is the phenomenon which gaseous molecule reaches the surface of an adsorbent and remains without chemical reaction. This mechanism may be intermolecular electrostatic or van der Waals forces, or may depend on the physical configuration of the adsorbent. Also, physisorption unit may be regenerable adsorbents. Whereas chemisorption is the phenomenon which gaseous molecules adhere to the surface of the adsorbent by means of a chemical reaction and the formation of chemical bonds and typically release 10-100 kcal/g-mol that is higher than physisorption. In addition, chemisorption usually occurs only at temperature greater than 200 ^{o}C when activated energy is available to make or break chemical bonds. Regeneration of chemisorbent is often either difficult or impossible. Therefore, in term of application, physisorption is more preferable for common adsorption than chemisorption.

Besides, the purpose of air pollution control, the adsorption is not the final treatment because the adsorbent will be saturated by adsorbate molecule. The surface area of adsorbent is unable to adsorb more pollutant, and then it needs to be cleaned out or regenerated by heat or lower temperature to reverse the adsorption process which regains the adsorbed solvent for use. Other eliminations are secure landfill and incineration. The formal disposal way may effect on environment by vapor evaporation directly from landfill, however, incineration can eliminate the VOCs eventually and friendly to environment by releasing only basic gases such as CO_2, H_2O, etc.

Generally, adsorption technology is applied for organic compounds and preferable for those which molecular weight is higher than 45. General adsorbents that have been dominated the commercial use of adsorbent are activated carbon, silica gel, activated alumina and zeolites.

The characteristics of adsorbent are depending on the raw materials properties, surface area, pore size, and surface charge density, which are interfered by water vapor. So, organic carbon adsorption requires the non-polar adsorbent such as activated carbon or nonionic material, or plastic. Anyhow, after saturated by VOCs, almost of the adsorbent are disposed together with the adsorbate that consumes a number of natural resources. This study, therefore, focus on the new adsorbent that could be enhanced their properties to resist at high thermal regeneration such as ceramic and baked clay in such a way that it could be reused and regenerated many times. Additionally, clays are often available in local sources and prepared by replacing the exchangeable inorganic cations present in clay particles with quaternary salt to develop their properties into organophillic materials. This modified or pillared clay will obtain more porosity, microporous characteristics, which are significant for organic carbon adsorption in the same practice as activated carbon.

Accordingly, PILC or modified clay is an interesting alteration to develop new adsorbents in terms of industrial application because the raw materials could be available from local and also its physical properties can be developed into various adsorbents by selection of pillaring agents and corresponding adsorbates. Moreover, PILC or modified clay is a new product which possses higher strength or could be used to support for other adsorbent and can be used in high temperature conditions. It can minimize activated carbon or other resource consumption and indirectly reduce energy consumption as well.

1.2 Objective

1.2.1 To develop organoclay by either pillaring or adding some porous material

1.2.2 To determine the proper dehydration condition that increase micropore of modified clay

1.2.3 To compare the cost of manufacturing between modified clay and conventional activated carbon

1.2.4 To study on the capacity of benzene, toluene and xylene adsorption of modified clay and other productions

1.3 Scope of Study

1.3.1 Study on raw clay material from Koh Kred Traditional Village and raw bentonite compared with activated carbon Filtrasorb-300

1.3.2 Determine the appropriate dehydration treatment conditions during 300-600 ^{o}C and air-drying to obtain higher surface area and more porous pillared clay and bentonite which are properly used for volatile organic carbon adsorption

1.3.3 Compare the different aging time that effect on pillared bentonite surface areas

1.3.4 Study on the composite of pillared clay or bentonite and activated carbon to develop new composite adsorbents

1.3.5 Compare benzene, toluene, and xylene adsorption capacity between commercial activated carbon Filtrasorb-300 and modified clay and/or modified bentonite

1.3.6 Identify the effect from thermal condition on surface areas and yield reduction of modified bentonite and activated carbon

1.3.7 Compare cost of manufacturing between modified clay and commercial activated carbon

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1.4 Anticipated Benefits

1.4.1 To provide new benzene, toluene and xylene adsorbent that posses better characteristics than conventional adsorbent

1.4.2 To prepare the database for development of modified clay for other corresponding adsorbates

1.4.3 To minimize the cost for enhancing new adsorbent, reduce long term cost and resources consumption, and also reduce the industrial adsorbent waste