I. INTRODUCTION

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1. Background

Water contamination by heavy metal is a major concern for environmental preservation and human health. Chromium is a type of heavy metal originated from industrial activities of leather tanning, dye, mining, iron sheet cleaning, textile dying, cement industries and electroplating industries. Depending on the type of industry, chromium's concentration in wastewater may vary from about ten to hundreds of mg L⁻¹ [1-8]. While Cr are obviously carcinogenic and posses adverse potential to modify the DNA transcription process, it can also cause epigastric pain, nausea, vomiting, severe diarrhea, asthma, pneumonitis, dermatitis and hemorrhage [1, 6, 7, 9].

A large variety of treatment methods to remove chromium are in fact available, namely chemical reduction [6], ion exchange [2, 4-7, 9-12], filtration [6],electrochemical treatment [5, 6], reverse osmosis [5, 7, 11, 13], adsorption [2, 4, 5, 10, 11] and solvent extraction [5, 10, 13]. Yet for low chromium concentration cases, most of them is considered ineffective due to high capital and operational costs incurred beside its low removal efficiency. Adsorption on the other hand, is already well-known for its selectivity and effectiveness on even a very minute concentration of contaminants case. Cost of adsorbent, however serves as a barrier for its industrial application as nearly all commercially available adsorbent are expensive. Numerous studies have been and are still conducted to screen and pinpoint alternative adsorbent that can satisfy the

Removal of Chromium (VI) from Aqueous Solutions by Durian Shell

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industrial demand from both performance and economic perspectives, including different kinds of biomasses.

On recent reports, numerous biomasses have been tested as alternative adsorbent to remove chromium (VI) which include tamarindus indica seeds [14], Acinetobacter sp. [15], almond shells [5], Aspergillus Sydoni [8], Bacillus licheniformis [16], cactus leaves [5], Chlorella miniata [1], Chlorella vulgaris [9], dried activated sludge [17], Eichhornia crassipes [18], Rhizopus arrhizus [13, 19], Saccharomyces cerevisiae [20], Strepmoyces Rimosus [10], Pseudomonas Aeruginosa [12]. Most of them have high adsorption capacity and therefore are worthy to be acknowledged. In order to be viable for industrial-scale application, however several criteria for adsorbent are required, namely (1) high adsorption capacity (2) high availability in large quantity within one location (3) low economical value (less advantage for other purpose) and (4) high reusability potential (attached metal can be easily removed). Indeed, nearly all of asmentioned alternative adsorbent already fulfilled 2 or 3 of these criteria. The second criteria, yet imposes the most difficult condition as for some microorganisms, their isolation, screening and harvesting in large scale are complicated and very expensive, preventing their utilization in industry, unless they can be obtained as waste or by-product of industrial fermentation process.

Although most biosorption studies have been centered on finding a new alternative adsorbent; this spotlight is still considered important and attractive due to its interdisciplinary challenge, mystery of biomass-metal interaction and unsolved heavy metals threat towards the environment faced by most developing countries. As a developing country, Indonesia also faces serious heavy metal pollution problem on its environment to the extent that many regulations have been issued by the Indonesian government. Direct discharge of waste and wastewater onto river and ground surface by most industry are still the main practice attributable to the economic constraints and lack of adaptable technology. To that end, leftover durian shells which are commonly available in large quantity without any further economic value are highlighted here to verify their potential employment as adsorbent so that they can be used further instead of ending as a merely waste.

Previous studies using durian shell as adsorbent has been done by Chandra et al [161]. They use activated carbon from durian shell to adsorb methylene blue from aqueous solution. Because the process of activating durian shell into activated carbon need a long time and chemical materials, it is not effective from economical site for wastewater treatment. Therefore here study directly durian shell as adsorbent.

This paper highlights various aspects in Cr adsorption onto durian shell. The characterization of pristine and Cr-loaded durian shell is given followed by reliable sorption equilibria and kinetic data presentation. The mechanism of Cr (VI) adsorption is also elaborated together with its thermodynamic aspects.

2. Objective

- 1. To study the adsorption capacity of durian shell to Cr (VI).
- To study isotherm adsorption and adsorption kinetics of Cr(VI) using durian shell as adsorbent.
- 3. To study thermodynamics of Cr(VI) adsorption using durian shell as adsorbent.

3. Limitations

- 1. Raw material used was the shell waste of durian.
- 2. Adsorption of Cr(VI) were studied using $K_2Cr_2O_7$ solution.