Prification of Arsenic Contamination with Activated Carbon derived from Jatropha Curcas Fruit Shells

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1. Introduction

Arsenic is well-known as the famous factor of groundwater contamination. Recently, arsenic contamination is remarkable in the water shortage area, depends on groundwater for water supply. Such area exists in South of Baja California state located in arid land has little superficial water. Although arsenic contamination coming from mining activities, arsenic threat will widen thorough the over use of groundwater and continual mining activities.

In general, water contamination is purified by expensive chemical treatment. However the advanced water treatment is unadoptable to rural areas and poor municipalities. Activated carbon water treatment is acceptable for these cases with cheaper cost than others.

In this research, the purification of arsenic contamination is implemented with activated carbon made from new cheap material referring to actual contaminated area in Mexico.

2. New Material

The material of activated carbon can be various organic matters even agricultural waste. On previous research, Agricultural waste of *Jatropha Curcas*, which will be heavily cultivated for alternative energy as bio-fuel, was successfully produced by cheaper production cost than commercial activated carbon in India, for removal of heavy metals selenite, chromium(Ⅵ), Nickel(Ⅱ), Vanadiun (Ⅴ) (Navasivayam 2007) except arsenic.

Furthermore, the research of Navasivayam (2007) shows the approximate calculation in production process, similar to the process in this research. The production cost of Jatropha activated carbon was 0.5 U.S. dollars per kg, while that of the commercial activated carbon was 3.00 U.S. dollars per kg in India. Even additional chemical activation, the price would increase the cost of Jatropha activated carbon only 5-10 percent.

Considering vegetations of Jatropha, arsenic contamination area (Fig.1), Jatropha activated carbon would be available at the southern South American continent, West coast thorough the United States and Mexico and India.

Fig.1 Arsenic Contamination

(Asia Arsenic Network)

3. Experiments

This research was implemented targeting the temporal reservoir for irrigation in South of Baja California state. In addition, the subject substance was focused on arsenic(Ⅴ) because arsenic(Ⅲ) would be oxidized in aerobic environment in the temporal reservoir. In addition, activated carbon adsorbs specific arsenic chemical form on pH conditions. Therefore the experiments are implemented with pH controlled arsenic(Ⅴ) solution prepared by NaOH and HCl.

Purification experiments were carried out in 100 Erlenmeyer flask with 50mg activated carbon, sieved 212-500µ particle size, made from Jatropha Curcas fruit shells and 50ml pH controlled arsenic solution 500ppb, based on arsenic concentration in South of Baja California state (Flor cassasuce et al. 2005), at adsorbable pH 4~9 (Fig.1), 150rpm, 25℃ in a thermostated rotary shaker.

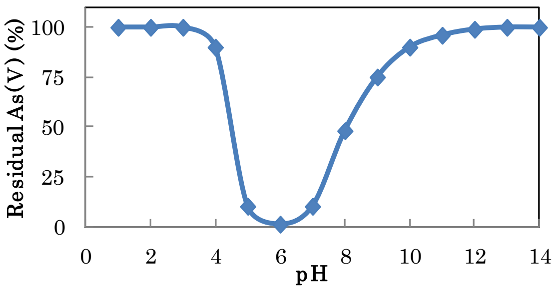

Fig.1 Arsenic adsorption on various pH with activated carbon (Kameyama 1979)

4. Analysis

The analysis method was followed to a standard method of inductively coupled plasma spectroscopy (ICP) Hydride Generator in Testing Method of Industrial Wastewater. In this experiment, the analytical pretreatment was carried out using experimented arsenic (V) solution with potassium iodide (200g/l) and hydrochloric acid (1N).

Arsenic concentration was measured spectrophotometrically to evaluate adsorptive capacity of produced activated carbon by arsenic wavelength 188.980nm, 193.696nm, 197.198nm.

5. Result and Discussion

General removability of activated carbon made from Jatropha Curcas fruit shells was found under the experiences between pH 4~9 as same as the early research (Kameyama 1979). The result presented in Fig.2 shows that Jatropha activated carbon has significant adsorption capacity compared with coconut activated carbon. Very good removal of arsenic (V) was observed for Jatropha activated carbon on pH 4 ~ 9. Moderate pH condition was observed for pH 4 ~ 6, though more than Coconut activated carbon. Nevertheless, the adsorption efficiency of Jatropha activated carbon was totally far better than Coconut activated carbon in comparison with the removal performance on wide pH condition.

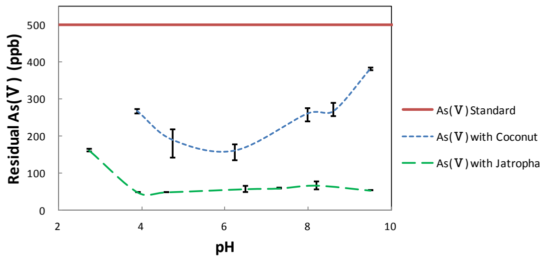

Fig.2 Influence of pH on Arsenic Adsorption on Jatropha activated carbon and Coconut activated carbon

Based on standard evaluation method adsorption, the isotherm adsorption equation evaluates the relation between the adsorption capacity and adsorbates on Jatropha activated carbon and Coconut activated carbon. The equations are presented in Fig.3 using pH controlled to good adsorption pH 4 ~ 6 and different concentration 0.5ppm, 1.0ppm, 2.0ppm.

By Fig.3, adsorption equation was formed nearly straight lines. It was expected that suitable equation would be Freundlich adsorption equation, an empirical equation related on amount of adsorbate and equilibrium concentration under the situation reached an equilibrium state. The equation has some parameters, "W" meaning amount of adsorbate on activated carbon, "1/n" meaning Index of adsorption, Kf meaning adsorption performance of activated carbon, "C" meaning equilibrium adsorption concentration.

$$W = K_f C^{\frac{1}{n}} \qquad (1)$$

The result is presented in Table 1 shows that the values of equation factors. Numerially the n value of Jatropha Activated carbon 1< n< 2 means that the activated carbon was suitable for water purification on flow system. Coconut activated carbon was unsuitable compared with Jatropha activated carbon. Furthermore according to "Kf" value, Jatropha activated carbon totally had higher adsorption capacity and the affinity between adsorbate and adsorbent than Coconut activated carbon. However, according to "1/n" value, Coconut activated carbon had the higher affinity than Jatropha activated.

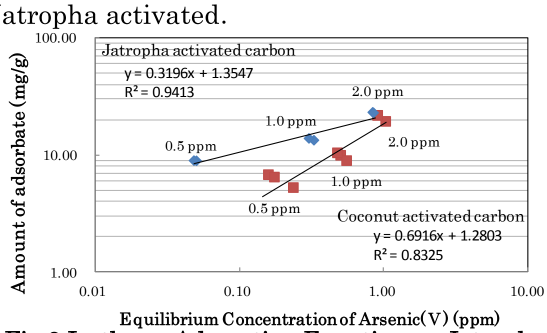

Fig.3 Isotherm Adsorption Equation on Jatropha and Coconut activated carbon

Table.1 Parameter and Inclination of Freudlich Adsorption Equation

Jatropha Activated Carbon		Coconut activated carbon	
Kf=	22.63	Kf=	19.07
n=	3.13	n=	1.45
1/n=	0.32	1/n=	0.69

6. Conclusion

Activated carbon made from *Jatropha Curcas* fruit shells, an agricultural waste, would purify arsenic (V) contamination water on wide pH range. Preliminary experiments show that the Jatrpopha activated carbon can be used as an effective adsorbent to purify the arsenic contamination.