Asian Journal of Chemistry; Vol. 26, No. 16 (2014), 5268-5270

ASIAN JOURNAL OF CHEMISTRY

http://dx.doi.org/10.14233/ajchem.2014.17176

Preparation of Super Absorbent Polymer Utilizing Corn Husks

YUNHUI LI[1], WEI LIU[1], YANCHUN MA[2], YING GAO[1,*] and XIUYUN YANG[1,*]

[1]School of Chemistry and Environmental Engineering, Changchun University of Science and Technology, Changchun 130022, P.R. China
[2]Jilin Provincial Institute of Education, Changchun 130022, P.R. China

*Corresponding authors: Tel/Fax: +86 431 85582361; E-mail: yangxiuyun@cust.edu.cn

Received: 7 February 2014; *Accepted*: 13 May 2014; *Published online*: 28 July 2014; AJC-15675

To find high value-added utilization for corn husks, a series super-absorbent sample were prepared with corn husks mass ratio between 10 and 15 % based on acrylic acid plus corn husks, heated with hydrothermal. The maximum absorbency of the composite in deionized water and tap water were 295, 261 and 75 g/g in saline, respectively. The result of treating hogwash oil indicated the dehydration rate of up to 95 % and remained keeping a high absorbency of 145 g/g.

Keywords: Corn husks, Cross-linked poly-acrylic acid sodium, Super absorbent resin, Hogwash oil.

INTRODUCTION

Hogwash oil is made from left overs, contains a lot of bacteria and toxins, once people eat will produce great harm to human body. Reasonable utilization of hogwash oil such as making bio-diesel is the most effective way to solve this problem. Enzyme catalysis is one of the best ways but water poisoning has been bio-diesel industrialization of technical barriers. In the current technology, vacuum distillation dehydration process costs a lot. To look for a low cost dehydration technology has become a more important measure.

Corn husks are the growth media of corns which are harvested and generally readily available since there are corn farms in most areas nearly of every country. Corn husks are expected to form super-absorbent resins through appropriate modification, since they are generally composed of such natural polymers as cellulose, protein, polysaccharides and lignin, which can be grafted by acrylic acid and/or its derivatives.

Super-absorbent resins can absorb more water as much as thousand times of its original weight and the swelled can retain liquid even under some pressure[1]. They are widely used in hygiene, agriculture, horticulture, drug delivery and food storage[2,3]. Most of them are synthetic polymers, which are derived from nonrenewable resources such as petroleum and poor in biodegradability to remain environmental problems[4,5]. In recent years, a variety of materials have been tried to avoid the environment problems and to enhance economic performance. Particularly, the natural polymers, such as starch, cellulose, proteins and chitosan have attracted great attention due to their abundant resources and degradability[6,7]. In this article, corn husks are mixed and reacted with acrylic acid under hydro-thermal synthesis. The method is low cost and has been achieved in the industrial production.

EXPERIMENTAL

Corn husks were cleaned up with water and cut to pieces, drying in the drum wind drying oven at 80 °C. Acrylic acid (AA), ammonium persulfate (APS), N,N-methylene-bisacryl amide (MBA) and other agents used were all of analytical grade and used as purchased and all solutions were prepared with distilled water.

Pretreatment of corn husks: Natural material structure and composition is more complex, we can only rely on what they showed to take advantage of some of the functions and properties. Dry corn husks can absorb about seven times depend on its own volume in water, the air adsorbed in the pores of the corn husks would automatically escape when corn husks were soaked in water and sink down to the bottom. Folic acid is present in natural leaves. Leaf surface has a layer of cuticle, contains long chain fatty acids with 17-18 carbon atoms. For the air escape out, corn husks must be treated with acrylic acid. The results manifest that corn husks treated with acrylic acid could get a good quality resin but sodium hydroxide could not in the same situation.

Preparation of the absorbents: Weigh corn husks and add to the acrylic acid solution soak for 5-6 h. Under a low speed of stirring the solution add the sodium hydroxide solution slowly, for the heat produced in the process could diffuse in the time. Until the solution get cool at room temperature add ammonium persulfate and N,N-methylene-bisacryl amide successively and proportionally. After 10 min stirring, cover the liquid level with polyethylene film, the purpose is to cut off from the air. And then put the beaker in the water bath pot heat for 1 h with 60 °C.

Measurement of equilibrium liquid absorbency: 1 g sample was weighed accurately and put in a beaker full of deionized water and saline, respectively. After different period take out the swelling resins on a 100 nickel mesh screen, record the mass of the rest samples when there is no more liquid drop off. The hogwash oil water content must be measured use a strong water absorption material such as $CaCl_2$, the specific method is put enough $CaCl_2$ particles in hogwash oil and stirring for 0.5 h, then filter with 100 mesh sieve. Clean up the hogwash oil on the surface of the particles with diethyl ether, measure the rest mass after the diethyl ether volatile completely.

RESULTS AND DISCUSSION

Synthesis products of super absorbent resins: In a series of investigations of the preparation and properties of super absorbent polymers, a number of aspects have been explored, such as the ultimate capacity for absorbing water, rate of absorption and the dependence of absorption on monomer composition, degree of crosslinking, type of crosslinker and type of polymerization process, as well as on temperature and initiator concentration[8-10]. According to the response of different material of the products, we used different concentration of crosslinking agent and initiator respectively. Table-1 shows that different state of the samples with the corresponding mass concentration.

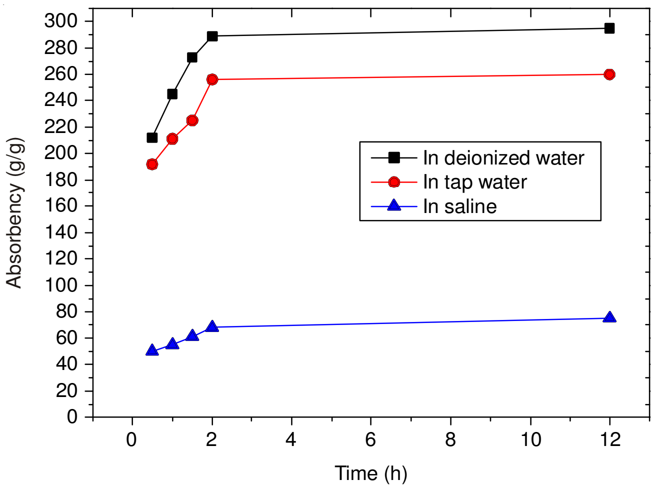

Fig. 1. Sample absorbency in different solutions

The difference between **1**, **2** and **3** in Table-1 is the corn husks in group **2** was treated with NaOH solution and the group **3** was treated with acrylic acid solution. The result indicates that treated with NaOH could not get the desired product. The gel strength of product in group **4** is lower, so we slightly adjusted the amount of crosslinking agent and initiator and the strength of the sample was improved[11]. Choose the ratio in group 5 to synthetic samples and the absorbency shows in Fig. 1.

Sample absorbency for water in different solutions

The impurity ions make bibulous rate difference, the result indicates in Fig. 1 is that the sample absorbency of water in tap water the maximum is 261 g/g, it is lower than in deionized water of nearly 30 g and the maximum absorbency in saline is 75 g/g.

Using the calcium chloride method to determine the moisture content, the water cut of hogwash oil is 50 % wt. Several samples prepared with measuring 300 mL hogwash oil in a beaker, add 1 g resin in and measure the absorbency during different time, respectively. Fig. 2 shows that the absorbency in hogwash oil is 145 g/g, the water absorption rate is up to 95 wt. %.

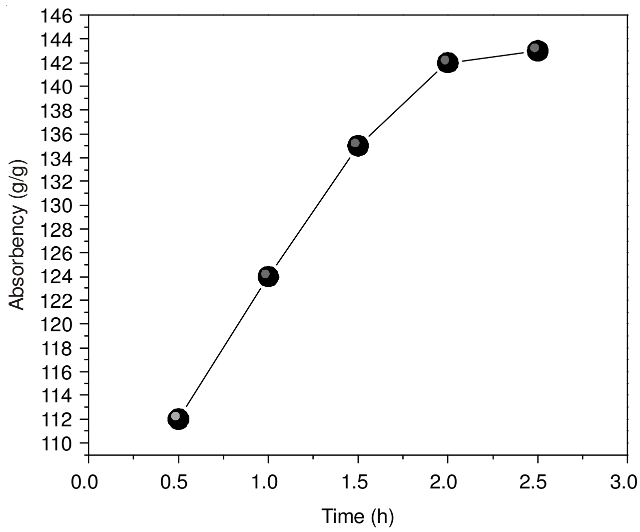

Fig. 2. Hogwash oil dehydration ratio

Conclusion

The preparation of a kind of high water-absorbing resin and natural organic compound absorbent material was synthesized, corn husks content is up to 15 wt. % and material can bear a certain degree of water absorption rate such as 295 g/g in deionized water, on the single hogwash oil dehydration

TABLE-1
PRODUCT WITH DIFFERENT REACTANT CONCENTRATION (FIGURES ARE IN wt. % AND g)

Group	Corn husks	Acrylic acid	NaOH	N,N-Methylene-bisacryl amide	Ammonium persulfate	Product
1	10%	50%65	15%96	1%2.5	1%16.25	No resin
2	10%	50%65	15%96	1%20	1%20	No resin
3	10%	50%65	15%96	1%20	1%20	Linear gel
4	15%	50%65	15%96	2%10	2%10	Crosslinking soft gel
5	15%	50%65	15%96	2%15	2%12.5	Crosslinked gel block

efficiency is up to 95 wt. %. Meanwhile, a simple and effective preparation process is obtained, which is advantageous to realize the demand of mass production.

ACKNOWLEDGEMENTS

This work was financially supported by Project of Development and Reform Commission of Jilin Province (2011003-7).

REFERENCES

1. J. Chen and K. Park, *J. Control. Rel.*, **65**, 73 (2000).
2. H. Omidian, S.A. Hashemi, P.G. Sammes and I. Meldrum, *Polymer*, **40**, 1753 (1999).
3. P.V. Dadhaniya, M.P. Patel and R.G. Patel, *Polym. Bull*., **57**, 21 (2006).
4. J. Zhang, A. Li and A. Wang, *React. Funct. Polym*., **66**, 747 (2006).
5. J.P. Zhang, Q. Wang and A.Q. Wang, *Carbohydr. Polym*., **68**, 367 (2007).
6. D. Gao and R.B. Heimann, *Polym. Gels Netw*., **1**, 225 (1993).
7. H. Shimofuruya, *Kiyo-suzuka Kogyo Koto Senmon Gakko*, **32**, 105 (1999).
8. F. Askari, S. Nafisi, H. Omidian and S.A. Hashemi, *J. Appl. Polym. Sci*., **50**, 1851 (1993).
9. H. Omidian, S.A. Hashemi, F. Askari and S. Nafisi, *J. Appl. Polym. Sci*., **54**, 241 (1994).
10. H. Omidian, S.A. Hashemi, F. Askari and S. Nafisi, *J. Appl. Polym. Sci*., **54**, 251 (1994).
11. R. Ding and K. Gong, *J. Appl. Polym. Sci*., **130**, 1098 (2013).