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Extraction of High-Quality Silica from a Plant Using a Simple Method

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ABSTRACT

Silica occupies an increasingly important place in scientific research, mainly due to its easy preparation and wide applications in various industries, such as catalysis, pigments, pharmaceuticals, electronics, ceramics, polymeric materials, thin film substrates, thermal insulators and moisture sensors. Silica is the second most abundant element on the earth's surface, accounting for around 32% of its total weight. Consequently, plants rooted in the soil always contain some silicon in their tissues. The nature of amorphous silica in plants (plants with a high silica content) means that it can be extracted at a lower temperature, and therefore provides a low-energy method as an alternative to current high-energy silica extraction methods. Among these methods an acidification method is applied in our case to extract silica from a plant. So the first part is to collect, sort and clean properly our plant before being burnt in a muffle furnace at 630°c to produce an ash powder in a first step then this powder was synthesized into silica by a chemical attack of nitric acid HNO_3 with a well determined concentration to form a silica powder. The physico-chemical characteristics of the synthesized powder were analyzed by X-ray diffraction and Fourier transform infrared spectroscopy (FTIR), with the result that the silica powder has an amorphous structure.

Keywords: silica; plant; extraction.

1. Introduction

Wastes generated by agriculture and the food industry, such as rice husks, sugarcane bagasse, corn cobs and banana leaves, are considered biomasses that provide an abundant source of silica. Synthesizing silica from these natural resources/wastes in a cost-effective way is currently one of the anticipated strategies for widespread applications.

2. Experimental Materials:

Nitric acid HNO_3 and the plant

Figure 1: photo of dried plant

In the first stage, the plant is collected, sorted and cleaned with distilled water, then placed in a free air oven for drying. The second step consists of placing 25g of the plant in a muffle furnace at 630°C for 8h. The third stage involves chemical attack with nitric acid, so a certain volume is added to the ash obtained from combustion in a beaker with constant stirring at 80°C for 2 hours. This is followed by washing and drying at 50°C for 24 hours to obtain a silica powder.

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3. Results and Discussion

3.1 FRX analysis

%	Sio_2	Cuo	SO_3	cl	K_2o	Tio_2	Cr_2o_3	Fe_2o_3
Plants	90.78	0.1642	0.2762	0.2427	3.11	0.0825	0.012	0.6053

3.2 DRX analysis

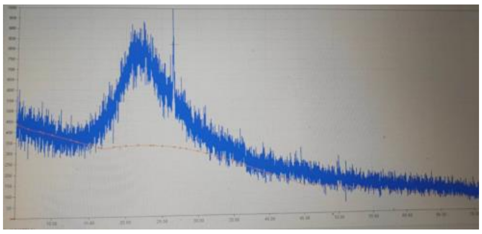

Figure 2: structural spectrum of silica extracted from biomass

The X-ray diffractogram of amorphous silica extracted from biomass ash is shown in figure 1. The broad X-ray diffraction pattern typical of amorphous solids shows that the extracted silica is predominantly amorphous. The diffraction peak at = 24 degrees confirms the formation of amorphous silica with crystalline silica.

3.3 FTIR analysis

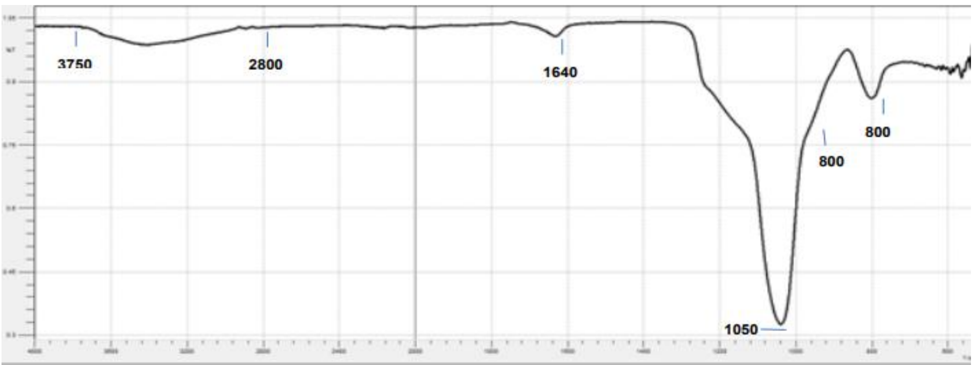

Figure 3: FTIR spectrum of silica extracted from biomass

The FTIR spectrum of the SiO_2 material extracted from the plant shows bands at 1050 cm^{-1} attributed to the predominant Si-O-Si asymmetry characteristic of silica. The sharp peak at 800 cm^{-1} represents symmetrical Si-O stretching and bending. The broad band between 3750 and 2800 cm^{-1} and the shoulder at 950 cm^{-1} were attributed to the asymmetrical stretching and bending vibrations of silanol OH groups (SiO-H) and adsorbed water, respectively [.while at 1640 cm^{-1} belonged to H-O-H bending. The FTIR data clearly confirmed that the final product was silica.

4. Conclusions

This simple method allows us to extract high quality silica with an amorphous structure from the plant.

References

[1]: Palanivel Velmurugan a, Jaehong Shim b, Kui-Jae Lee a, Min Cho a, Sung-Sik Lim c, Sang-Ki Seo c, Kwang-Min Cho d, Keuk-Soo Bang e,*, Byung-Taek Oha,** "Extraction, characterization, and catalytic potential of amorphous silica from corn cobs by sol-gel method" journal of industrial and engineering 29(2015)298-303

[2]: Vineet Vaibhav , U. Vijayalakshmi , S. Mohana Roopa '' Agricultural waste as a source for the production of silica nanoparticles ''spectrochemica acta part A :molecular and biomolecular spectroscopy139(2015)515-520

[3]: Nor Surayah Osman, Norzahir Sapawe Optimization of silica (SiO2) synthesis from acid leached oil palm frond ash (OPFA) through sol-gel method''materials today :proceedings 31(2020)232-236

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