HOW TO GET HIGH ADDED VALUE PRODUCTS FOR INDUSTRIAL APPLICATIONS FROM AGRICULTURAL WASTES

PATENTED TECHNOLOGY

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ABSTRACT

The research group *Carbonaceous Materials and Environment* of the University of Alicante has developed a simple process to obtain activated carbon (monolithic) from an agricultural residue scarcely used to date, such as cocoa shell, whose characteristics and technical features make it highly suitable for several industrial applications such as environmental decontamination, liquids and gases treatment and heterogeneous catalysis applications, among others.

This process allows developing porous structures in a controlled way, without using binders or additional steps for consolidation. It can be applied to any mixture of agricultural and forestry residues. It is environmentally friendly and its industrial production requires low cost. The research group is looking for companies interested in acquiring this technology for commercial exploitation.

INTRODUCTION

Nowadays, development of new adsorbent materials is promoting due to its importance for many industrial applications. In this sense, synthesis of new porous carbonaceous materials (activated carbon) have become particularly promising because of the high internal porosity, and therefore, they have become optimal candidates for different applications, such as environmental decontamination, gas treatment, gas storage and heterogeneous catalysis, among others.

Synthesis of new adsorbents with a tailored internal pore structure has been extensively studied, focusing also on an economic and environmental point of view. In this sense, the use of agricultural or forestry wastes as raw material for activated carbon are quite interesting, obtaining a final product with high added value and high industrial interest (in fact, the demand of good quality charcoal exceeds supply).

There are many different procedures to obtain activated carbons with good porosity using vegetable wastes as raw materials, such as, for example, coconut shell, walnut shell, almond shell, olive, cherry and peach bones, or grain husks. In most of these cases, due to the process used in its preparation, activated carbons in powder form are obtained, which are not appropriate for treating gas streams and liquid flows due to the problems caused, such as falling pressure in the flow, clogging or fouling of the product to be purified, due to dragging activated carbon fines. Therefore, the use of pieces of activated carbon is more appropriate for these applications.

In order to obtain activated carbon monoliths, it is needed an organic additive (binder), which is mixture with a suitable ratio of the activated carbon powder. This mixture is conformed in the geometrical piece desired, which is heat treated to confer mechanical strength to the piece. The binders commonly used are: humic acid, PVA, phenolic resin, Teflon and cellulose, among others.

TECHNICAL DESCRIPTION

Taking into account the above comments, present invention shows an easy synthetic process to obtain activated carbon pieces (monolith) from an agricultural residue unused to date, as it is the cocoa shell.

For the preparation of activated carbon from cocoa shell, the required steps are:

1. Mounding of cocoa shell monolith through pressing.

2. Carbonization of monolith on inert atmosphere until a desired temperature, in order to obtain a carbon monolithic.

3. Activation of carbon monolith on carbon dioxide atmosphere, a fixed temperature during a specified time, in order to development porosity on the carbon piece to get an activated carbon monolith.

Optionally, before pressing (step 1), the cocoa shell can be washing with acidified water in order to remove the mineral matter of cocoa shell. This pretreatment of cocoa shell are suitable in order to development a higher porosity on the final product.

Through this procedure, it is possible to obtain activated carbon monoliths with a well-defined geometrical shape and good mechanical strength (see Figure 1).

Figure 1: Activated carbon monolith obtained from cocoa shell during the three different steps (from left to right): mounding, carbonized and activated

The activated carbon monoliths obtained are suitable for applications in different industrial sectors because of its porous texture (essentially microporous). This microporosity (pore size lower than 2 nm) is similar that is found with other activated carbon precursors, such as: tar, cellulose, anthracite, etc.

ADVANTAGES AND INNOVATIVE ASPECTS

MAIN ADVANTAGES

- It is a very simple procedure.
- This technology allows develop activated carbon with a controlled porous texture.
- It allows revaluate vegetable waste into a high added value product for industrial interest.
- This procedure can be applied to any mixture of agricultural or forestry wastes and it requires low cost production.
- Raw material does not need additional binders, since show self-binder properties.
- It does not required additional steps to strengthen monoliths.
- It has a suitable microporous structure for applications in industrial flows (liquid or gas).
- The obtained monoliths have a high mechanical strength.
- This technology is viable (technically and economically).
- It is environmentally friendly.

INNOVATIVE ASPECTS

- The use of cocoa shell as a new lignocelulosic precursor to preparate activated carbon (monoliths) for industrial applications.
- In contrast with current procedures used to synthesize activated carbon monoliths, in the present invention, the mounding of precursor is made before the carbonization and activation steps.
- Raw material shows self-binder properties, so it is not necessary additional binders or additional steps for consolidation.

CURRENT STATE OF DEVELOPMENT

The technology has been successfully tested at laboratory level. The research group has the know-how for industrial scale-up.

MARKET APPLICATIONS

This procedure takes place within the field of materials technology, and in particular, it relates to a method for synthesizing activated carbon monoliths from agricultural wastes.

Specifically, it is a viable revaluation (technically and economically) of cocoa husks for activated carbon monoliths in applications of different industrial sectors, such as:

- Environmental remediation (for example: pollutant removal from air).
- Gas storage.
- Separation of gas mixtures.
- Purification of gas streams.
- As drying agent.
- Removal of impurities.
- Recovery and concentration of fossil fuels.
- Heterogeneous catalyst.
- Catalyst support.

COLLABORATION SOUGHT

The research group is looking for companies interested in acquiring this technology for commercial exploitation:

- License agreements.
- Search for funding opportunities to develop new applications, adapted to the specific needs of the company.
- Technology and knowledge transfer agreements.

INTELLECTUAL PROPERTY RIGHTS

This technology is protected through patent :

- Title: “Procedimiento de síntesis de monolitos de carbón activo a partir de cascarilla de cacao”
- Application number: P201300737
- Application date: 5th August, 2013

MARKET APPLICATION (5)

Agri-food and Fisheries
Pollution and Environmental Impact
Wood and Furniture
Materials and Nanotechnology
Chemical Technology