HIGHLY MICROPOROUS ACTIVATED CARBON FROM AN SPANISH ANTHRACITE WITH HOMOGENEOUS PORE SIZE DISTRIBUTION

TECNOLOGIA PATENTADA

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RESUM

The Department of Inorganic Chemistry of the University of Alicante has developed technology and process to prepare activated carbons with a homogeneous micropore size distribution.

Interestingly, the chemical activation by KOH of the Spanish anthracite produces an activated carbon with a very homogeneous micropore size distribution (almost exclusively microporosity of size between 0.7-0.9 nm. and BET surface areas close to 2000 m2/g.



DESCRIPCIÓ TÈCNICA

It is well-known that materials of low cost and high carbon content can be used as precursors for the production of activated carbon and that the current trend is toward increasing use of cheap and readily available precursors as coals and lignocellulosic materials.

The use of coals as activated carbon precursors could be an alternative to develop the market for this special use of coal. The use of Spanish coals as feedstocks for the production of activated carbons is of interest to our country as reflected by several projects being carried out at different universities and research institutes, granted by the ECSC (European Community of Steel and Coal), Ocicarbon, and the Science Ministry. This interest is a consequence of the large coal production (31.7 metric tons in 1993), and reserves and the current exclusive use of the Spanish coal as feedstocks for combustion processes.

The Department of Inorganic Chemistry of the University of Alicante works since 1983 in activated carbons. Preparation of activated carbons with a given pore size distribution is a field of active research in which different precursors and preparation procedures are analysed. The Department has the expertise for the preparation and characterisation of activated carbons from different precursors. Materials of low cost and high carbon content as lignocellulosic materials, coal and carbon fibres can be used as such as precursors for the production of activated carbons. Mainly, two preparation procedures are available for the preparation of these materials:

• The first possibility is the controlled gasification of carbon by reaction with CO2 and steam.

• The second one is the so-called chemical activation in which the carbonaceous precursor is impregnated with a given chemical agent and pyrolysed. The pyrolysis process is usually done at lower temperature than that used in the controlled gasification process.

The Department has analysed the activation of Spanish coals using the above methods. Different pore size distribution result depending on the rank of the coal and the activation process. Coals of different ranks develop microporosity by chemical activation, but an increase in the development of the largest pores is observed with decreasing the rank. Coals of lower rank present a wider porosity distribution.

Especially interesting results have been obtained by chemical activation of Spanish anthracite with KOH. As it is well known,

KOH is a good activating agent but the resulting activated carbons have a heterogeneous porosity in the range of 1-2 nm and very high surface area (for example the commercial AX21).

Interestingly, the chemical activation by KOH of the Spanish anthracite produces an activated carbon with a very homogeneous micropore size distribution (almost exclusively microporosity of size between 0.7-0.9 nm) and BET surface areas close to 2000 m2/g. Although its surface area is lower than the AX21, its porosity is much more useful for many applications. Thus, the characterisation of this material has shown to be of relevance for several important technological applications.

The chemical activation process presents the great advantage, compared to physical activation, of removing the inherent mineral matter of the coal. Activated carbons obtained by chemical activation exhibit much lower ash content than the corresponding original coals. The mineral matter content, abundantly present in Spanish coals, produces an undesirable effect: the increase of the inert part of the samples.

AVANTATGES I ASPECTES INNOVADORS

INNOVATIVE ASPECTS:

• Materials of low cost and high carbon content as lignocellulosic materials, coal and carbon fibres can be used as precursors for the production of activated carbons.

• Different pore size distribution depends on the coal rank and the activation process.

• Very interesting properties are obtained by chemical activation of Spanish anthracite.

ESTAT ACTUAL

The technology is available for demonstration.

APLICACIONS DE L'OFERTA

The characteristics of the activated carbon from Spanish anthracite have shown to be of relevance for several important technological applications like:

• Gas storage (CH4)

• Gas separation (O2/N2, CO2/CH4)

• Gas phase adsorption (elimination of odours, flavours, organic impurities from drinking and waste water, some toxic chemicals, purification of air)

COL·LABORACIÓ BUSCADA

The partners sought are industries with interest in activated carbons. The Department of Inorganic Chemistry is interested in:

• Transfer its knowledge and know-how to the industry

• Apply its expertise in the develop of industrial pilot plants and technology in the areas of preparation

• Realise characterisations and applications in gas separation, gas storage and gas adsorption

DRETS DE PROPIETAT INTEL·LECTUAL

The investigation results have been published on several papers (see references below). There is a Spanish patent granted applied to the elimination of NOx.

PERFIL DEL GRUP D'INVESTIGACIÓ

University of Alicante - Carbon and Environmental Group

History

The University of Alicante was created in 1979 and has rapidly established itself in Spain as a prestigious university, particularly

in the teaching and research of science. The Carbon and Environmental Group involved in this research, belongs to the Department of Inorganic Chemistry in the Faculty of Sciences.

Personnel

The group was established in 1983 when Prof. Ángel Linares-Solano joined the University of Alicante. Currently, it comprises two other membres of the Faculty, Prof. Concepción Salinas-Martínez de Lecea and Prof. Diego Cazorla-Amorós, three Assistant Professors, two PhD Research Fellows and eight PhD students.

Research fields

The main research fields of the group are: activated carbon preparation and characterisation, carbon fibre preparation, gas adsorption, gas-solid reactions, heterogeneous catalysis, pollution abatement, gas separation and gas storage.

Experience

The experience of the group in research can be summarised as follows: during the last 10 years, 22 research projects have been carried out with financial support from the Spanish government, EC and private industries; 85 papers have been published in high quality scientific journals, 8 PhD Thesis have been completed and over 100 presentations have been made at international conferences. Regarding the EC funding, our group has participated in 6 projects (5 ECSC, 1 BRITE), being the co-ordinator of three of them.

SECTORS D'APLICACIÓ (2)

Pollution and Environmental Impact
Materials and Nanotechnology