PHARMA

CABOT

NORIT ACTIVATED CARBON

ALL YOU NEED TO KNOW TO MEET YOUR PURIFICATION NEEDS

Pharmaceutical industry

To be used for human intake, pharmaceutical products must be ultra pure and fully traceable. This is why the pharmaceutical industry chooses Cabot Norit Activated Carbon as an important tool for the purification of intermediates and end products. Activated carbon has a very high adsorption capacity for a wide range of molecules, varying from odorous compounds to dark colored bodies and proteins, and is often used for final polishing to remove residual color and odors.

Cabot offers more choices than anyother manufacturer of activated carbons made from a wide range of raw materials. Cabot products are available in several forms, ranging from powder to granular and extrudates. Our ability to control the activation process and the purity of the activated carbons at our dedicated plants provide a customized product for the end user. The best product fit for your application results in an overall improvement in the efficiency of your operation, and in the final quality of your product.

In this brochure you will find a five step plan to assist you in identifying the most cost-effective activated carbon for your purification needs and Cabot's commitment to support you in implementing our carbon into your operations.

CABOT

NORIT ACTIVATED CARBON

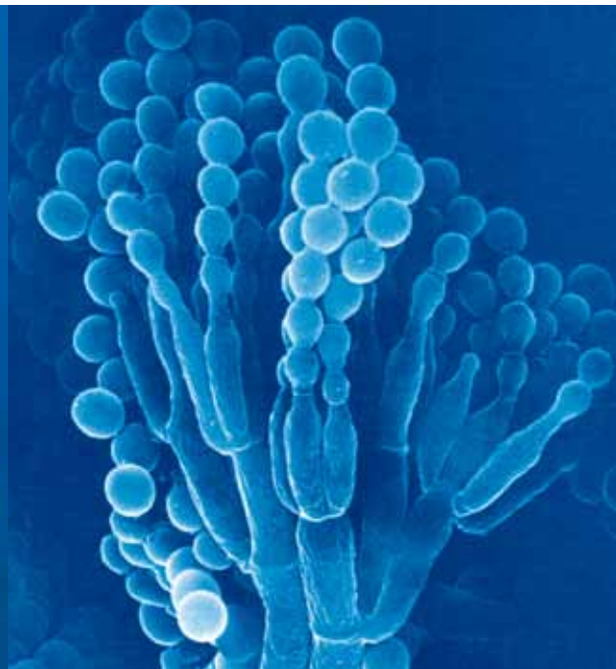
HOW DOES ACTIVATED CARBON WORK?

Activated carbon is a porous material consisting mainly of elementary carbon modified to have a large internal surface area. The pores trap organic contaminants. All activated carbons contain a broad range of – micropores, mesopores and macropores. Different activated carbons vary significantly in their distribution of pore size, depending on the activation method and the starting material involved.

Cabot is the manufacturer of the food ingredient E153

Organic impurities are trapped within the porous structure by adsorption. Adsorption is a term used to describe the process which creates a higher concentration of a substance at the interface between a fluid and a solid than is present in the fluid. It can be divided into physical adsorption and chemisorption. In physical adsorption the impurities are held on the surface of the carbon pores by weak Van der Waals forces whereas in chemisorption the forces are relatively strong and occur at active sites on the surface.

The efficiency of the carbon will therefore depend upon its accessible surface area (usually som what less than its total surface area), and also upon the presence of active sites upon the surface at which chemisorption may occur. Thus, activated carbon actually removes the impurity, unlike bleaching operations in which the colored impurity is only changed to colorless products.



MAIN APPLICATIONS

There are countless activated carbon applications in the pharmaceutical industry. This page is a selection of main applications where activated carbon is well established as the best choice for the purification of pharmaceutical products.

The selections suggest the diversity of tasks for which activated carbon can offer safe and cost-effective solutions.

Active Pharmaceutical Ingredients (API)
Active Pharmaceutical Ingredients are the core of your product and are often the result of numerous process steps and resemble a high value. For this type of products Cabot can help you with the final purification step with the optimum carbon reducing product loss. This also applies to special requirements concerning purity and/or characteristics required by your process. The products are fully traceable and inhouse produced.

Vitamins
Vitamins, including A, D, E, K, B, C, H and folic acid,are used on a large scale as food additives to ensure an optimal supply of these essential nutrients. Cabot products are used for the removal of color and other impurities during vitamin production. Activated carbon is also used for the isolation of vitamins in fermentation broths. These vitamins are later recovered.

Enzymes
Enzymes like amylase, glucose-isomerase, lipase, maxatase, and protease need to be decolorized before being used further in pharmaceutical processes. Cabot has developed activated carbons that are extremely effective in this task.

Penicillin
It is well known that penicillin can cure infections, either alone or in combination with clavulanic acid. Cabot products are used for the removal of color and other impurities from all types of penicillin. Activated carbon is also used for the isolation (by adsorption into activated carbon) of penicillin in fermentation broths. The penicillin is later recovered.

Painkillers
Painkillers have to be purified before people can use them. Examples of painkillers that are purified by Cabot products are acetaminophenone, caffeine, paracetamol, and salicylic acid.

Contrast media /Intravenous solutions
Only the purest activated carbons are used for the production of contrast media and intravenous solutions. Cabot products are extremely suitable for these types of purification processes, keeping any disturbance of actual process conditions to an absolute minimum.

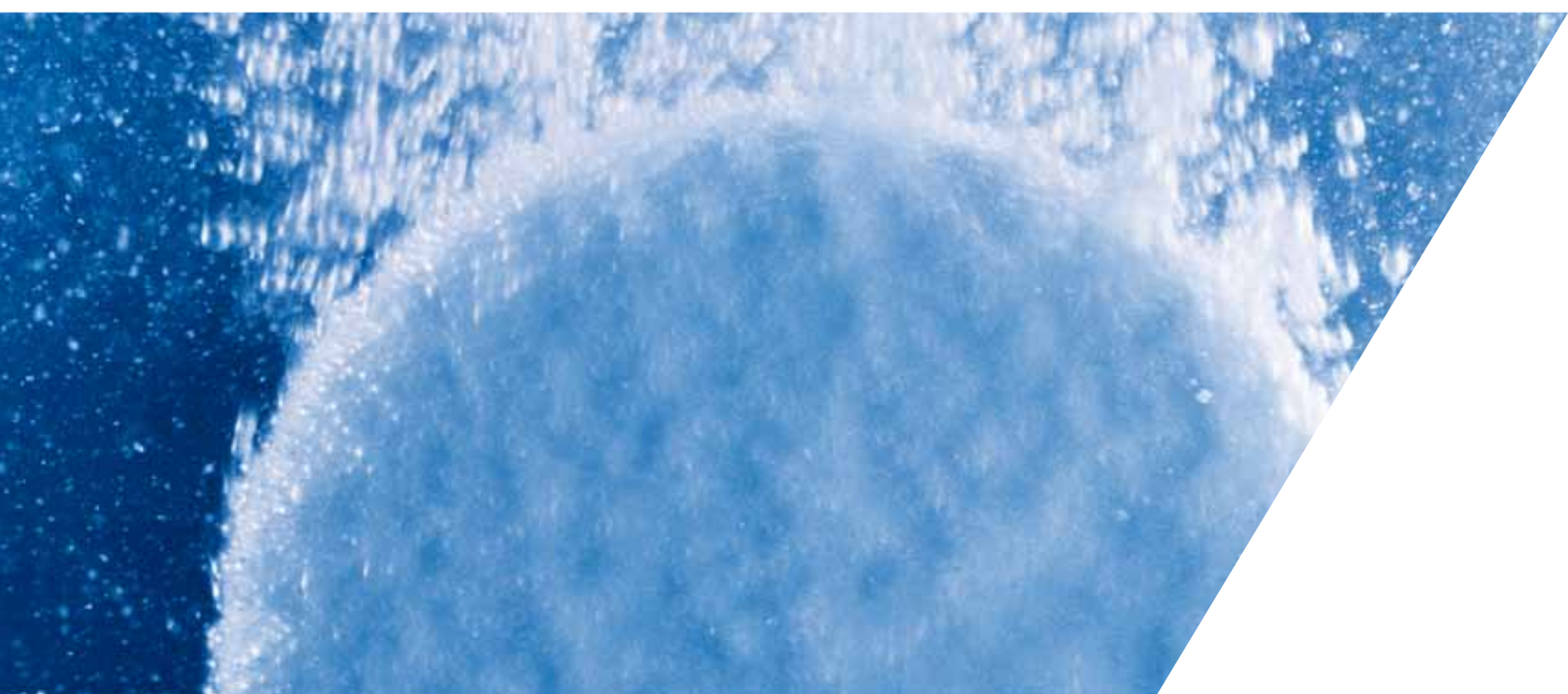
CABOT
NORIT ACTIVATED CARBON

SELECTION OF THE MOST COST-EFFECTIVE ACTIVATED CARBON

Five basic steps to selecting the right activated carbon for your application:

1. Decide on the basic treatment technology
2. List the impurities that have to be removed
3. Determine the purity level of the activated carbon
4. Select your activated carbon
5. Evaluate your activated carbon

PROTEINS.	Usually very large, found in many natural products
DARK COLORANTS (TYPICALLY DARK BROWN).	Present initially or formed during processing.
MEDIUM COLORANTS (TYPICALLY LIGHT BROWN/GOLDEN).	Present initially or formed during processing.
NATURAL PIGMENTS.	Responsible for many colour impurities.
PYROGENS.	Present initially or formed during processing.
LIGHT COLORANTS (TYPICALLY YELLOW).	Present initially or formed during processing.
COLOR PRECURSORS.	Responsible for color re-appearance during the storage of finished products.
ODOR COMPOUNDS.	Small, relatively volatile compounds.



(1) What basic treatment technology do you need?
The first task is to define the need, and understand where the treatment step must be placed to meet the treatment objectives. The two questions to consider are: Is the plant for one process or multi-purpose? Is the plant running continuously?' This leads to the initial selection of either Powdered Activated Carbon (PAC) or Granular Activated Carbon (GAC).

PAC is the best solution for batch processes. The dosage can be easily adjusted to ensure consistent purity requirements from a variable reaction stream. Pharmacopoeia grades are available – ensuring the highest guaranteed purity levels from an activated carbon. Powdered activated carbon is suitable for all purification processes, ranging from bulk decolorization to final taste and odor improvements.

GAC is typically used in processes requiring final polishing or running on a continuous basis. The process can be designed to maximize throughput by virtually eliminating downtime during change-out or regeneration. In some cases, GAC may be regenerated in place with steam or caustic, and Cabot provides off-site reactivation services at it's own facilities in North America, the Netherlands, UK, Italy or in cooperation with third parties. Consult our expert staff for further information on carbon regeneration.

(2) List the impurities to be removed
Once the optimal treatment technology has been determined for your process, it is time to consider the type of impurities to be removed. Activated carbons are used in a wide range of processes to remove widely differing impurities, like those listed below. They are removed by adsorption into the carbon pore structure. For effective adsorption, the pore diameter should roughly match the molecular size of the impurities.

Knowing what impurities have to be removed is the key to selecting the optimal activated carbon grades with the proven ability to adsorb identical or similar compounds.

(3) Determine the purity level of the activated carbon
Cabot offers products in three grades of purity: High Purity, Ultra Purity and Pharmacopoeia carbons

Activated carbon is used to purify a process flow – not to add impurities – so a carbon of the purity required has to be selected. Because activated carbon is produced from raw materials of vegetable origin, it contains trace levels of some impurities typically originating in these raw materials (e.g. wood contains calcium, coal contains iron) or from the activation agents used in chemical activation processes (e.g. phosphoric acid).

The most common impurity is quartz (SiO_2, which is insoluble in virtually all product media, and therefore has no effect on the quality of the product).

High Purity
In most processes an activated carbon of high purity will be adequate. At this level of purity, the concentration of soluble impurities is slight, and the carbon dosage is small relative to the amount of product being treated.All these carbons meet the U.S. Food Chemicals Codex requirements. In some cases, the impurities only influence the pH of the product being treated – in which case a pH corrected carbon may be used. Granular activated carbons have an initial effect on the pH of the product, though the effect subsides as the carbon continues to be used.

CABOT
NORIT ACTIVATED CARBON

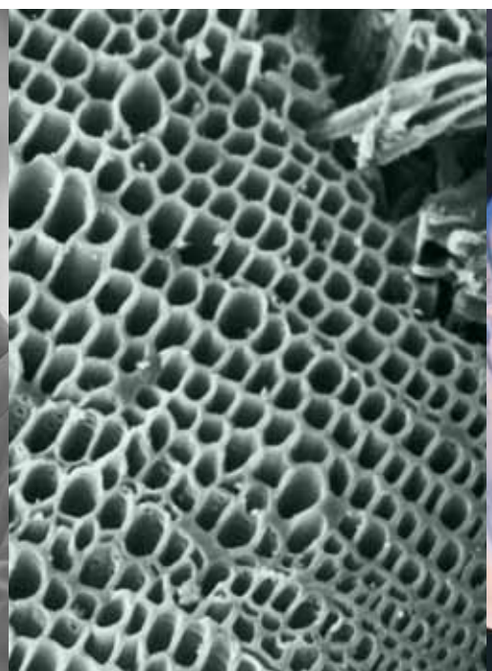
Ultra purity
In the Cabot ultra pure products, trace levels of impurities are virtually eliminated by careful selection of raw materials and by post treatment. Impurity levels meet stringent specifications, far beyond the requirements of the U.S. Food Chemicals Codex. This makes these activated carbons suitable for highly demanding applications. Due to their extremely low leachable impurity content they exert virtually no effect on solution pH.

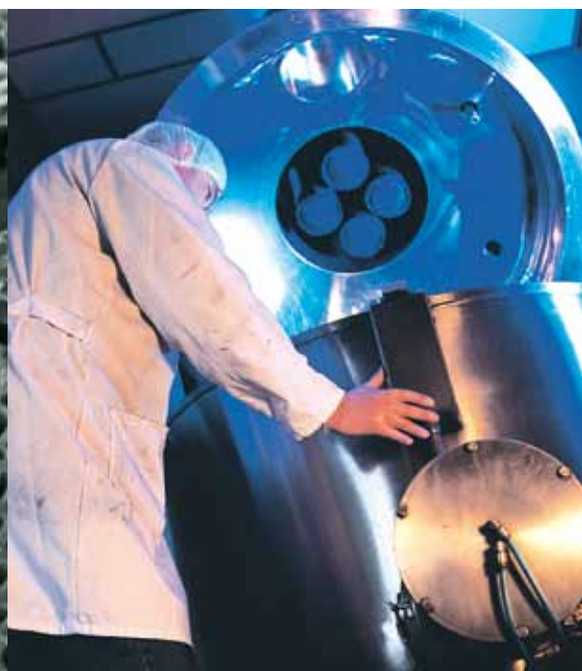
Pharmacopoeia carbons
The use of Cabot pharmacopoeia products can facilitate the process of drug registration. Cabot offers five different pharmacopoeia grade carbons of the highest purity and can produce them according to the requirements of the European and American Pharmacopoeias.

(4) Select your activated carbon
The carbon selection chart allows you to decide which standard Cabot products are suitable for your process. In cases where you have special process or quality demands, other grades may be recommended for the same purpose. For further information, contact your Cabot office, and visit our website at cabotcorp.com.

If you have requirements not covered in the selection chart, contact your Cabot office for further information on our product range. We produce over 150 grades of activated carbon from several raw material sources and therefore can provide an activated carbon to fit your process.

Cabot Norit Activated Carbon makes liquorice, caviar and eyeliner black





(5) Evaluate your activated carbon
Once you have decided on the activated carbon that fits your process, call your Cabot office for samples. We will also provide technical bulletins describing test methods to evaluate the most cost-effective PAC or GAC suited to your process. The results obtained from these test methods may then be directly scaled up to meet your process requirements.

PAC
is tested using a batch adsorption method. Different carbon doses are compared with a blank to evaluate:

- equilibration under controlled conditions, including contact time, temperature and agittion
- measurement of impurities before and after carbon treatment
- influence on pH

GAC
is tested by constructing adsorption isotherms at different test conditions to determine the theoretical loading at complete exhaustion. Reliable performance data are then obtained from in-plant tests, allowing a comparison of GAC grades and optimization of process conditions.

And there you have it.
The five basic steps needed to help you identify the most cost-effective activated carbon for improving the quality of your product.

Want to get the ball rolling?
Start by contacting your Cabot office for:

- An analysis of your activated carbon needs
- Technical bulletins
- Test information (PAC & GAC)
- Specific application information
- General information on activated carbon
- Product information and samples for testing

CABOT
NORIT ACTIVATED CARBON

TECHNICAL SUPPORT

- Ongoing technical support is always close at hand at Cabot.

- Cabot is dedicated to your activated carbon needs. This comes fromtaking our commitment to our customers very seriously. We call it partnership. The benefit to you is a guarantee of getting the best fit for your application. We will use our knowledge to do what is best for you, because we know that your best interest is in our best interest.

- Cabot serves customers worldwide, through an international network of sales and service support facilities. In fact, we manufacture activated carbon in seven plants around the world and we reactivate carbon in four plants. Cabot Norit Activated Carbon stands for safety and constant quality. With ISO certification for all our manufacturing and reactivation facilities around the world, quality assurance is built into the stringent quality processes for manufacturing and handling, from raw materials, to safe means of activation, to product delivery and dosing.

- Cabot products are regularly tested against the U.S. Food Chemical Codex standards. The products are manufactured entirely from raw materials of vegetable origin. The production processes comply with the requirements for the HACCP (Hazard Analysis Critical Control Points) system. No animal derived materials are used.

Cabot offers activated carbons specified to meet European and U.S. Pharmacopoeia standards.

Cabot 'purification for life'
Founded in 1918, Cabot Norit Activated Carbon is the world's largest and most experienced producer of activated carbon which is used to remove pollutants, contaminants and other impurities from water, air, food and beverages, pharmaceutical products and other liquids and gases in an efficient and cost-effective manner.

Cabot's history of innovation in purification allows us to develop the right product solution to meet each customer's needs. We have created more than 150 different grades of activated carbon – produced from a variety of raw materials – so that our customers get precise solutions that fit their applications and work better than an "off the shelf" product. In addition to our unparalleled product portfolio, Cabot offers a full range of activated carbon services including rental systems, carbon reactivation, bulk delivery and change-out, carbon evaluation, as well as technical service and support to help our customers cost effectively meet their specific purification needs.
Cabot has facilities in seven countries, and a network of sales and service centers, business partners, and distributors serving customers in more than 100 countries around the world.

CABOT
NORIT ACTIVATED CARBON

Cabot Norit Nederland BV
P.O. Box 105
3800 AC Amersfoort
The Netherlands
T +31 33 46 48 911
F +31 33 46 17 429
cabotcorp.com

Cabot Corporation reserves the right to make changes in the technical specifications at any time.

Pharma B/E 5-2013