



ACTIVATED CARBON FOR PURIFYING PHARMACEUTICALS



WE'VE BEEN MAKING ACTIVATED CARBON FOR 100 YEARS

Building on our 100-year history of innovation in product and manufacturing development, Cabot Norit Activated Carbon offers more choices for the pharmaceutical industry than any other manufacturer of 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, from odorous compounds to dark colored bodies to proteins, and is often used in the final polishing step to remove residual color and impurities.

Made from a wide range of raw materials, we offer more than 150 different grades of activated carbon and in several forms, ranging from powder to granular and extrudates. Our ability to control the activation process allows us to provide the products that meet the quality, purity and traceability requirements the pharmaceutical industry relies on. The result: an overall improvement in the efficiency of your operation and the final quality of your product.

MAIN APPLICATIONS

There are many activated carbon applications in the pharmaceutical industry where activated carbon is well established as being highly suitable for the purification of pharmaceutical products. The following selections demonstrate the diversity of tasks for which activated carbon offers safe, efficient and cost-effective purification.

Active Pharmaceutical Ingredients (APIs)

High value active ingredients are the core of pharmaceutical products and are often the result of numerous process steps. For these products, we can help identify the optimum carbon for the final purification step that will minimize product loss. We will also take into consideration special requirements concerning purity and other characteristics required by your process. Our activated carbons are fully traceable and produced in-house.

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. Our activated carbons are used for the removal of color and other impurities during the production of these vitamins. Activated carbon is also used for the isolation of vitamins in fermentation broths where they can be easily recovered.

Enzymes

Enzymes like amylase, glucoseisomerase, lipase, maxatase, and protease need to be decolorized before being used further in pharmaceutical processes. We have developed activated carbons that are extremely effective in this task.

Penicillin

For decades, penicillin has been used to cure infections, either alone or in combination with clavulanic acid. Our activated carbons are used to remove color and other impurities from all types of penicillin. Activated carbon is also used for the isolation of penicillin (by adsorption into activated carbon) in fermentation broths where it can easily be recovered.

Painkillers

All painkillers need to be purified for human consumption. Our activated carbons are commonly used to purify painkillers such as acetaminophen, caffeine, paracetamol and salicylic acid.

Contrast media/Intravenous solutions

Only the purest activated carbons can be used for the production and purification of contrast media and intravenous solutions. Many of our activated carbons meet or surpass the U.S. and/or the European Pharmacopoeia purity requirements and are extremely suitable for these types of purification processes.

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
 - powdered activated carbon (PAC)
 - granular activated carbon (GAC)
2. List the impurities that must be removed
3. Determine the right purity level of the activated carbon
4. Select your activated carbon
5. Evaluate your activated carbon's performance

	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 color 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

Figure 1. Matching carbon particle pore size to impurity molecular weight

PURIFICATION OF LEAD COMPOUNDS

Given the unlimited variety of new chemical entities produced in drug discovery, it is difficult to predict which activated carbon grade will work best at removing unwanted impurities from any given sample. For this reason, we created a sample kit (Figure 2) for pharmaceutical applications. It contains six high purity activated carbon grades with unique selectivity for removing a range of common impurities while maximizing yields of promising lead compounds.

Now, process chemists in early drug development can easily develop a chemical process that is safe, reproducible and cost-effective with one convenient activated carbon kit. By trying one chemically activated and one steam activated carbon, they can determine which type works best. Then by trying different grades, they can determine the effectiveness of the activated carbons and optimize the purification method further, enabling the scaleup of promising lead compounds for clinical trials in less time.



Figure 2: Activated Carbon Sample Kit

Benefits

- ◆ Includes activated carbon grades for adsorption of unwanted colors, process impurities, metals and catalyst traces
- ◆ Purify more lead compounds in less time
- ◆ Maximize yield of target compounds while selectively removing unwanted impurities
- ◆ Improve efficiency with a convenient benchtop sample kit
- ◆ Technical support at hand for further optimization



PURIFICATION OF ACTIVE PHARMACEUTICAL INGREDIENTS

Many on-patent and bulk drug manufacturing processes employ the use of bulk powdered activated carbon (PAC) and granular activated carbon (GAC) in a critical purification step to make the active pharmaceutical ingredient (API) safe for human use. The primary impurities include unwanted colors, metals, catalyst traces (formed by-products) and process-related impurities.

The typical process involves several steps. First, bulk PAC is dosed into a mixing vessel and mixed with the product solution. This involves agitation for sufficient time to allow the impurity molecules to come in contact with and be adsorbed by the PAC. Finally, bulk PAC is removed from the process after adsorption of impurities takes place. Bulk carbon is usually removed by a cake filtration process where particles build up on the surface of a filter sheet forming a cake. These adsorption and polishing filtration steps yield a pure solution.

We have developed an activated carbon portfolio specifically to meet the needs of the pharmaceutical industry. This includes grades with unique selectivity that meet or surpass the U.S. and/or the European Pharmacopoeia purity requirements (Figures 3A and 3B).

Our powdered activated carbons (PACs) for pharmaceutical purification

Product	Category	Activation	pH	Impurity type				Activated carbon characteristics	
				Small (off white colors, odors)	Medium (yellow colors)	Large (brown colors, proteins)	Metals (Pd, Pt, Rh, Ru)	Purity	Filtration
NORIT® A SUPRA EUR/USP	Pharmacopeia	Steam	Neutral	●	◐	○	○	●	◐
NORIT B TEST EUR/USP	Pharmacopeia	Steam	5.0-8.0	◐	◐	◐	○	●	●
NORIT C EXTRA USP	Pharmacopeia	Steam	Neutral	◐	●	◐	◐	●	◐
NORIT METPURE	Metal impurities	Chemical	2.0-3.5	○	◐	◐	●	◐	◐
NORIT SX PLUS	Broad use	Steam	Neutral	◐	◐	◐	◐	◐	◐
NORIT SX ULTRA	Broad use	Steam	Neutral	◐	◐	◐	◐	◐	◐
NORIT SXIG	Small/Med impurities	Steam	Neutral	◐	◐	◐	◐	◐	◐
DARCO® G 60	Small/Med impurities	Steam	Neutral	◐	◐	◐	◐	◐	◐
NORIT DX ULTRA	Small/Med impurities	Steam	Neutral	◐	●	◐	○	◐	◐
NORIT CAI	Large impurities	Chemical	2.0-3.5	○	◐	◐	◐	◐	◐
NORIT CN PREMIUM	Large impurities	Chemical	5.5-6.0	○	◐	◐	◐	◐	◐
NORIT CGP PREMIUM	Large impurities	Chemical	3.5-6.0	○	◐	●	◐	◐	◐
DARCO S-51	Large impurities	Steam	4.3-7.0	○	◐	◐	◐	◐	◐

Figure 3A

Our granular activated carbons (GACs) for pharmaceutical purification

Product	Category	Activation	pH	Impurity type				Activated carbon characteristics
				Small (off white colors, odors)	Medium (yellow colors)	Large (brown colors, proteins)	Metals (Pd, Pt, Rh, Ru)	Purity
NORIT ROX 0.8	Broad use	Steam	Neutral	◐	◐	◐	○	◐
NORIT GAC 1240 PLUS	Broad use	Steam	5.0-8.0	◐	◐	◐	○	◐

Figure 3B

● Best ◐ Better ◑ Good ◒ Fair ○ Poor

ACTIVATED CARBON FILTER DISCS

Currently, our activated carbon grades are the preferred choice of leading industry filter disc manufacturers, including 3M, Pall and Ertel-Alsop. We make our activated carbon grades available to filter disc manufacturers so pharmaceutical chemists are provided with an uninterrupted migration path from PAC to filter discs as they scale-up and manufacture APIs.



Figure 4. Filter discs

Contact your local sales representative for a complete list of grades offered in a filter disc format.

Filter discs immobilize activated carbon within a resin-cellulose matrix and provide several benefits (Figure 4):

1. Cleaner product format
2. Reduces cross-contamination risk
3. Reduces time consuming validation steps
4. Offers benefits of filtration and adsorption

ACTIVATED CARBON AS A NUTRACEUTICAL OR ACTIVE PHARMACEUTICAL INGREDIENT

Due to its high degree of microporosity, just one gram of powdered activated carbon can have a surface area of > 2000 m²/gram and is highly effective for treating diarrhea, gas, bloating and acute poisoning. It works by adsorbing gas and gas-producing substances that are natural by-products of digestion. Activated carbon can also adsorb poisonous substances from the digestive tract, eliminating the root cause of diarrhea.

We offer several grades of activated carbon for use in capsules and tablets (Figure 5). They are sold as active pharmaceutical ingredients and as over-the-counter nutraceuticals worldwide. NORIT® B TEST USP activated carbon is our newest activated carbon for capsules in North America given its density specification and compliance with the U.S. FDA Food Safety Modernization Act (FSMA).

We also provide contract manufacturing services for activated carbon in capsules, tablets and liquids in our highly regulated good manufacturing practices (GMP) certified facility.

Region	Product	Capsules	Tablets	Density specification	Density range	
					kg/m ³	lb/ft ³
North America	NORIT B TEST USP*	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	470-510	29.3-31.8
	NORIT E SUPRA USP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	285-310	17.8-19.4
Rest of the world	NORIT B TEST EUR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	415-495	25.9-30.9
	NORIT B SUPRA EUR	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	370-400	23.1-25.0

Figure 5: Cabot NORIT activated carbon grades for capsules and tablets

* Complies with U.S. FDA Food Safety Modernization Act



AHEAD OF THE CURVE ON PURIFICATION

Building on our 100-year history of innovation in manufacturing and product development, Cabot Norit Activated Carbon is the world's most experienced and one of the largest producers of activated carbon serving customers in more than 100 countries with manufacturing facilities in seven countries. Our products are used to efficiently and cost-effectively remove pollutants, contaminants and other impurities from water, air, food and beverages, pharmaceutical products and other liquids and gases. We have developed more than 150 different grades of activated carbon – produced from a variety of raw materials – that provide our customers with precise solutions for their specific application needs. Additionally, we offer a full range of activated carbon services including rental systems, carbon reactivation, bulk delivery and change-out, carbon evaluation and direct technical support.

Our sales, technical service and customer service teams are prepared to serve customers around the world. Contact us at cabotcorp.com/activatedcarboncontact



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