



Activated
Carbon
for Water
Processes

WATER. The supply of clean, fresh water is rapidly becoming more and more constrained as populations rise and demand for high quality water grows around the world.

The challenge is multifaceted. Increasing regulatory pressures require tighter and tighter limits on various contaminants in drinking water supplies and wastewater discharges. Increasing standards of living dictate consumer demand for better tasting water that is free of off-colours and odours. Increasing industrial processes also require cleaner feed water quality.

As these various demands for improved water quality continue to grow, pro-active solutions are needed.

The Proactive Company



Earth is a closed ecosystem and the total amount of water it contains essentially remains constant. Of the available water, less than 1 percent is usable by humans.



The world's most precious resource for drinking, irrigation and industrial processes.

AVAILABLE TECHNOLOGIES FOR cleaner water continue to develop. Jacobi provides granular, powdered, extruded and liquid activated carbon of the highest quality manufactured from a wide range of raw materials to address any water treatment issue.

Our high level of technical competence places Jacobi in the position of providing guidance regarding the choice and operating conditions of the activated carbon so that you achieve the best performance. Customers are also helped with recycling and reusing spent carbon at our reactivation locations, and Jacobi provides filter services as well as mobile filtration units for rent or purchase.



One of the best solutions for a variety of water purification issues is the tried and true technology utilizing activated carbons.



Customers get advice and consultation in order to achieve the best activated carbon performance.

The Solution
Company



Untreated sewage flows into rivers, lakes, and coastal waters causing a wide variety of acute illnesses from pathogens like bacteria, parasites, and viruses.

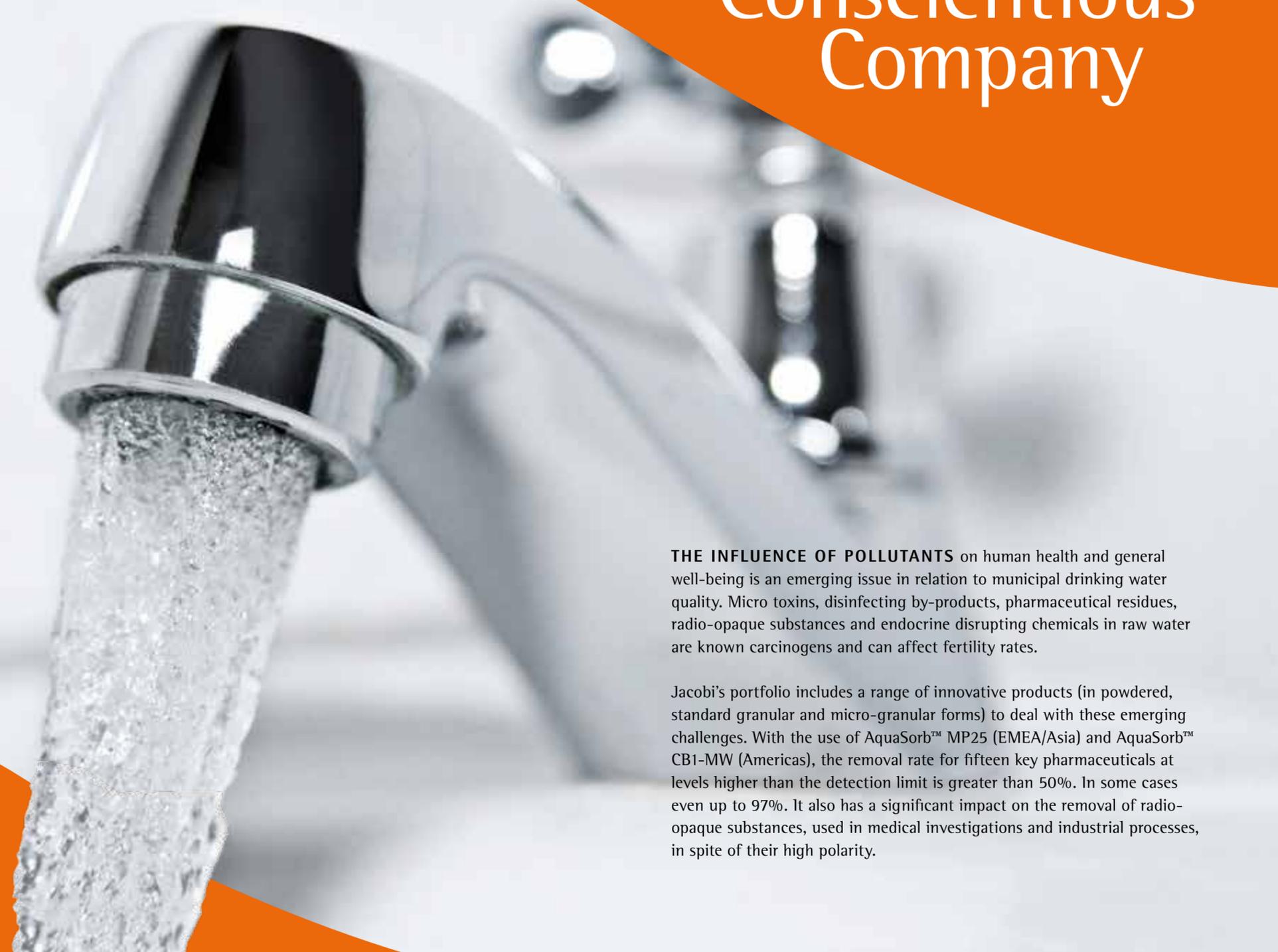


Different water treatment processes remove the bulk of dissolved organic compounds (COD), suspended solids and colloids. The residual COD and toxic materials are adsorbed using granular or powdered activated carbon.



Compared to other activated carbons the removal efficiency of selected pharmaceutical products at levels higher than the detection limit is 50%–97%.

The Conscientious Company

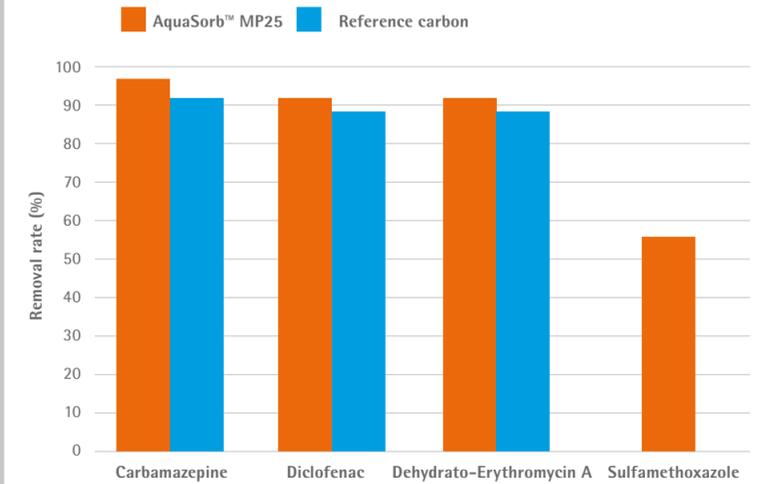


THE INFLUENCE OF POLLUTANTS on human health and general well-being is an emerging issue in relation to municipal drinking water quality. Micro toxins, disinfecting by-products, pharmaceutical residues, radio-opaque substances and endocrine disrupting chemicals in raw water are known carcinogens and can affect fertility rates.

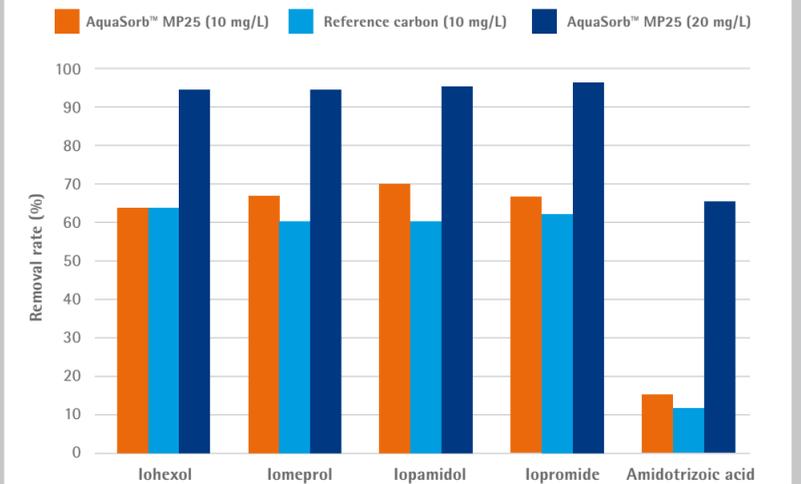
Jacobi's portfolio includes a range of innovative products (in powdered, standard granular and micro-granular forms) to deal with these emerging challenges. With the use of AquaSorb™ MP25 (EMEA/Asia) and AquaSorb™ CBI-MW (Americas), the removal rate for fifteen key pharmaceuticals at levels higher than the detection limit is greater than 50%. In some cases even up to 97%. It also has a significant impact on the removal of radio-opaque substances, used in medical investigations and industrial processes, in spite of their high polarity.

Removal efficiency of selected pharmaceutical products

PAC dosage: 10mg/L

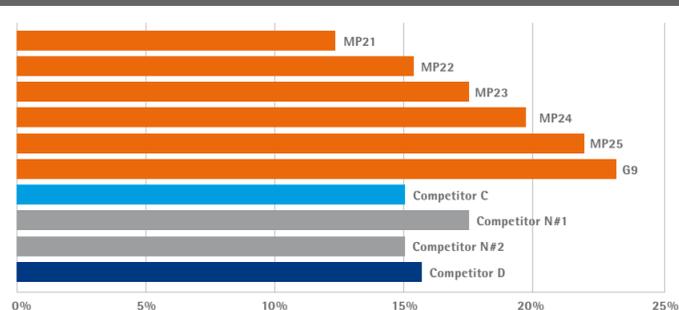


Removal efficiency of selected radio-opaque compounds

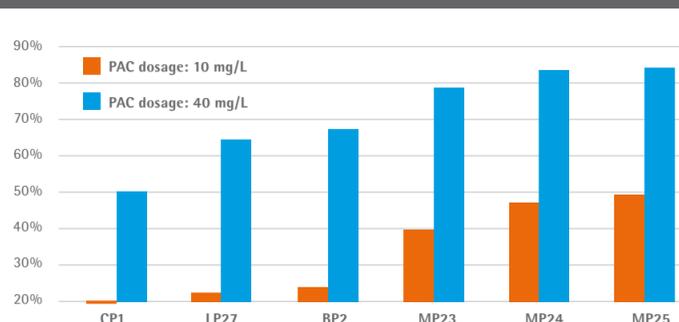


AQUASORB MP-SERIES PRODUCTS ARE SOLD EXCLUSIVELY IN THE EUROPEAN UNION REGION. AQUASORB CB-SERIES PRODUCTS ARE AVAILABLE IN ALL OTHER TERRITORIES.

Removal efficiency of organic matter by different PAC's
(Tc = 10 min – PAC dose = 20 mg/L)

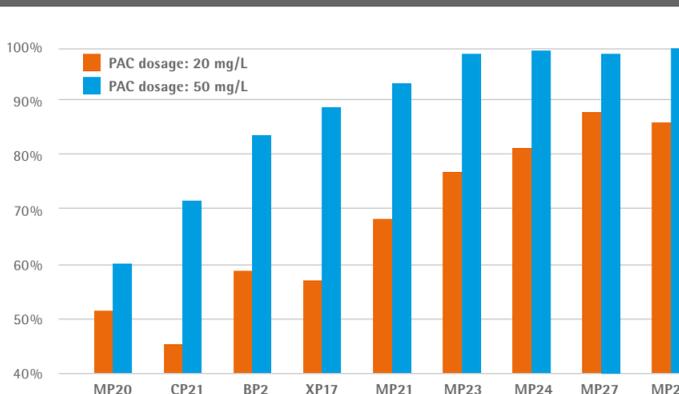


MIB removal efficiencies
(PAC from the AquaSorb™ range)



Compiling of several test results done on tap water spiked at a target concentration of 100 ng/L of MIB. Kinetic tests at 20 minutes of contact time. In the presence of organic matter.

Atrazine removal efficiencies
(PAC from the AquaSorb™ range)



Trials on Cher river raw water done by PICA Jacobi Lab in Vierzon (France) in 2011. Kinetic tests at 10 minutes of contact time. In the presence of organic matter.

OVER THE YEARS the amount of natural organic matter (NOM) has increased in raw water supplies in several areas. This originates from rainwater run-off, groundwater seepage or biological activity in surface water sources. In reservoirs and rivers, the degradation of algal blooms causes an earthy-musty taste and issues with odour.

Organic chemicals like Geosmin and Methylisoborneol are the two major causes for unwanted tastes and odours. Although they represent a minor health risk, the water is unpalatable. Once considered a seasonal phenomenon, this is increasingly becoming a year-round problem due to the higher average temperatures and heavy periods of rainfall.

The removal of organic matter, as well as chemicals used in agricultural and industrial applications, relies on treatment by activated carbons. Our AquaSorb™ range is tailored to target NOM. It is available in granular (GAC) or powdered (PAC) form, depending on the equipment at the treatment facilities, and the nature, duration and persistence of the treatment target.

Jacobi provides a comprehensive solution for all water production and treatment sites. It consists of liquid and customised particle size activated carbons, static and mobile PAC dosing equipment and temporary GAC adsorption units. Our in-house service teams can assist with fixed installations to help in management, exchange and regeneration of our customers' activated carbon.



Increasing regulatory pressures require more stringent limits on contaminants in wastewater discharges and drinking water supplies.

The Purifying Company



Activated carbons help remove chemicals for pest control in agricultural settings.



Natural Organic Matter (NOM) is prevalent in many water sources where degradation of algal blooms result in unpalatable water. Organic chemicals like Geosmin and Methylisoborneol cause an earthy-musty taste and odour, fortunately the majority of these compounds can be removed with activated carbons.

THE USAGE OF domestic consumer water treatment devices is on the rise. All over the world more homes are equipped with coffee machines, refrigerator dispensers, personal water bottles and baby milk dispensers. Activated carbons have always played an important role when it comes to filtration systems for residential water use. For a long time jug filters, faucet mounted units and other Point of Use (POU) systems have provided an extra measure of security for home users.

As a Point of Entry (POE) these systems can also provide pure water for specific areas of larger buildings by removing sterilising agents, industrial chemicals and residual pesticides that may exist or become added to domestic and municipal water supplies. Jacobi's AquaSorb™ CX, LS and GXB are widely used in consumer water treatment devices.

For decades, activated carbon has been used as a filtration medium for fish aquariums. Jacobi provides AquaSorb™ HXC that has wide spectrum adsorption properties and low phosphate content. In swimming pools, granular activated carbon serves in the removal of residual low molecular weight organics generated by the action of adding ozone to the water. Recommended products include AquaSorb™ CR, CX-MCA and CP.

AquaSorb™ CR, CX-MCA and CP are granular activated carbon products that is used in the removal of residual low molecular weight organics generated by adding ozone to the water in swimming pools.



The Everywhere Company



AquaSorb™ HXC is a specially treated product with a wide spectrum of adsorption properties and low phosphate content that is used as a filtration medium in fish aquariums.



A great cup of coffee always begins with great tasting water.



Jug water filters, and other Point of Use (POU) systems, using activated carbon provide an extra layer of protection and provide pure, clean drinking water.

The Treatment Company



Jacobi can assist with a team of dedicated testing experts.

EFFLUENT WATER ORIGINATES from a variety of industrial, food manufacturing and waste management processes. Characterising and identifying particular compounds is often complex. Levels of dissolved organic compounds are measured as Chemical Oxygen Demand (COD), and include traces of toxic materials that disguise the real source of the pollutant.

Given the difficulties in determining the true nature of the challenge, using either simple static “jar” testing or pilot column trial allow users to ascertain if activated carbons is a cost effective, efficient and even possible treatment option. If required, Jacobi can assist in the preparation of testing and deployment of pilot equipment.

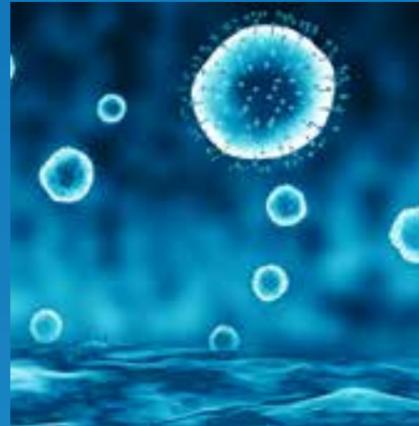
In effluent treatment plants, biological treatment techniques are used to remove the bulk of the COD. These are combined with settlement or flocculation steps to remove the suspended solids and the colloids. Water from the settlement tanks will often require additional mechanical filtration using sand filters. The residual COD and toxic materials are adsorbed by using granular (GAC) or powdered (PAC) activated carbons. Jacobi can also provide mobile filtration units for purchase or rent, to install in parallel or in series.



Mobile filtration units adsorb residual COD and toxic materials, and can be installed in parallel or in series.



Characterising and identifying particular compounds in effluent water is often complex.



The distinctive taste that is created by free chlorine (Cl₂) is not masked by adding flavour concentrate. During high temperature processes it can be liberated as an acidic gas, which leads to corrosion of equipment, damage of sensitive yeasts, and a hazardous work environment.

SOFT DRINK AND BREWING companies use water supplied by local municipalities. Water standards may vary within specification limits regarding suspended solids, trace organic compounds and the use of sterilising agents used to control bacterial contamination from the distribution system.

Pollutants can become concentrated or react with ingredients that can create off-tastes and exceed industry standard requirements. They may also lead to equipment damage and a hazardous work environment. Soft drink factories and brewing companies rely on activated carbons for dechlorination and removal of dissolved organics, including disinfecting by-products (DBP), such as trihalomethanes (THM).

Today, chloramines are increasingly replacing chlorine to sterilise municipal water supplies, due to the Stage 2 DPB Rule and less stringent handling controls. However, chloramines have been cited as a health hazard if ingested, and they are a more difficult contaminant to remove.

Jacobi's AquaSorb™ range – CX-MCA, CX, HX and H150 – efficiently eliminates undesired substances that cause undesirable taste and odour, making municipal water safe for beverage manufacturers and creating a consistently high quality. Our products can also be neutralized for a quick start-up of the filter.

The Refreshing Company



The beverage industry depends on high quality water commonly supplied by local municipalities. Specification standards may vary, and concentrated pollutants can create off-tastes as well as damage to equipment.



The Concerned Company



Detection is key to efficient removal of chloramines.



The effects of water pollution multiply as they move up the food chain. Higher levels of toxins are often found in larger fish because they retain the metals of the smaller fish that they eat.



Pollutants from industrial or agricultural processes spill into waterways and create toxic environments for fish and other wildlife.

PROCESS WATER AND ultra-pure water from industrial processes, sweet water reservoirs and landfill surface run-off may contain a cocktail of contaminants.

One of these are trihalomethanes (THM), which are formed by the reaction of trace organics in water supply by disinfection agents like chlorine.

Process water for highly sensitive manufacturing processes must be treated with mechanical nano-filtration membranes. By using a high activity and high purity activated carbon filter upstream of the membrane, damage from organic load or chlorine attacks is prevented. Activated carbons can even be impregnated for a bacteriostatic effect.

Activated carbons are versatile and provide a wide spectrum of adsorption capability to purify the most heavily polluted water streams, ensure compliance and limit environmental impact. Jacobi's AquaSorb™ LS, LX and LT ranges are registered by the American Environmental Protection Agency.

The Recycling Company



TREATMENT OF WATER in municipal and industrial facilities where granular activated carbon (GAC) is employed requires regeneration or reactivation. It is essential that this recycling process is conducted with little environmental impact, and in a cost effective way to ensure maximum effectiveness and return on investment. However, as the availability of suitable sites for disposal of waste material is scarce, costs continue to rise.

To control contaminants, both the regeneration and reactivation methods utilize a high temperature in a controlled environment. This effectively cleans and restores the available pore structure within the spent carbon so that it can be reused.



High temperature rotary kilns are used to remove contaminants from spent activated carbon.



Spent carbon must be lab tested to determine suitability for regeneration or reactivation.

So which method is the best? Many experts favour regeneration to ensure complete elimination of contaminants. Reactivation, on the other hand, can save money and it has low impact on the environment by reducing landfill waste. However, reactivation facilities cannot accept the return of any spent carbon until it has been tested and approved.

Jacobi operates two systems to manage our customers' reactivation needs. For drinking water applications we use ReSorb™ Solo. The spent granular activated carbons (GAC) is returned to the reactivation facility in food-grade kilns, and is then sent back to the customer with or without make-up of the virgin activated carbon. The process is carried out in individual batches to guarantee traceability and plant origin. With the ReSorb™ Pool systems, the spent carbon is returned to the reactivation facility and then retained for sale in Jacobi's ReSorb™ range.

AquaSorb™ product grades for municipal GAC/PAC

AquaSorb™	POWDER					GRANULAR				
	CP series	BP series	MP series CB series	G series	LP series	C series H series	1000 series HT100 series	5000 series	6000 series	PICABOL
Chlorine and chlorinated compounds	XXX	X	X	X	X	XXX	X	X	X	X
Hydrocarbons and phenols	XX	XX	XX	XX	XX	XX	XX	XX	XX	
MB and geosmin	X	XX	XX	XX	XXX	X	XX	XXX	XXX	X
Pesticides, herbicides...	XX	XX	XX	XX	XXX	XX	XX	XX	XX	
Organic matter (TOC)		X	XX	XX	XXX		X	XX	XXX	
microcystins			XX	XX	XX			XX	XX	
Humic acids				XX	XX				XX	
Colours				XX	XX				XX	

AquaSorb™ product grades for process water and industrial

AquaSorb™	POWDER					GRANULAR				
	CP series	BP series	MP series CB series	G series	LP series	C series	100 series	5000 series	L-series	Resorb series
Process water	X	X	X	X	X	X	X	X	X	X
Wastewater		X	X	X	X		X	X	X	X

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In emergencies, filter units allow efficient removal of a wide range of dissolved organic compounds (COD).



Mobile filter units can be operated in parallel or in a series to remove a wide array of contaminants.

JACOBI OFFERS EXCHANGE services in the form of mobile filter units. AquaFlow™ and EcoFlow™ are convenient solutions for treating effluents from a variety of liquid applications. The design allows liquid to be distributed uniformly through a bed of activated carbon. During operation the bed is permanently flooded with liquid to ensure the media is always prepared for service, even in intermittent use applications. The entire bed is also used for optimizing the life of the filter.

The mobile filter units can be placed in parallel to increase the processing rates, or in a series to improve the performance reduction. When the spent activated carbon reaches saturation, it is replaced in the existing filter with a new load. Spent activated carbons can be regenerated in a loop to return it at a later stage, or replaced with virgin GAC as the particular conditions of operation dictate. This design allows the efficient removal of a wide variety of dissolved organics. Operation in semi-static mode is particularly suitable for temporary or emergency use.

JACOBI'S MOBILE FILTER UNITS ARE AN EASY-TO-USE SOLUTION FOR TREATMENT OF:

- Potable water
- Process water
- Purification of solutions
- Process effluent water
- Groundwater treatment
- Process liquor purification



The Mobile Company



Jacobi's service teams are certified according to recognised health and safety standards, and can provide a full service package.

The Versatile Company

JACOBI'S ACTIVATED CARBONS are manufactured from a large range of raw materials to address any water treatment issue in the most efficient and cost-effective way. The selection of the correct activated carbon is critical, whether the challenge is in potable, process or waste applications.

Source materials include coconut, wood, lignite, bituminous and anthracite coal, and the activated carbon is manufactured by chemical and steam activation processes. All products are available in granular (GAC) and powdered (PAC) form. The anthracite coal based carbon is also formed into extrudates (pellets), as filter design often demands the use of a uniform particle size.

JACOBI'S PRODUCTS COMPLY WITH INTERNATIONAL AND LOCAL REGULATIONS:



Conformité Européenne
– EN 12903 and EN 12915



American Water Works Association
– AWWA B600 and AWWA B604



National Sanitation Foundation
– NSF61, Water Quality Association



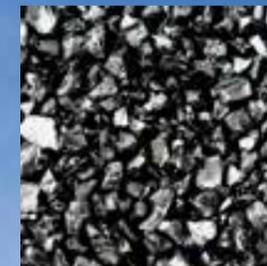
COCONUT

Coconut shell based carbon provides a highly microporous pore system, ideally suited for removal of low molecular weight compounds. The extremely low ash content makes it perfect when surface reaction is required, like in dechlorination or removal of ozone. Our AquaSorb™ C Series, provides an excellent range of grades based on coconut shell.



BITUMINOUS

The high durability allows repeated regeneration cycles to be performed with excellent recovery of product. Agglomerated or re-agglomerated, it generates a more mesoporous activated carbon with capacity for larger molecules. Bituminous coal carbons are available in our AquaSorb™ 1000 series (direct) and AquaSorb™ 6000 series (agglomerated) forms.



ANTHRACITE

This type of coal generates a less mesoporous structure, but increases the capacity for organics. It has higher purity even without secondary washing, and permits the development of material that meets stringent soluble matter criteria. Key products are AquaSorb™ LAK and GXB.



LIGNITE

This raw material has an extremely microporous and macroporous pore system making it ideally suited for medium to large molecules, like Geosmin, Methylisoborneol, colours and complex organic acids. It is offered in the AquaSorb™ 5000 series.



WOOD

Wood based carbon has a more highly developed mesoporosity (steam activation) and macroporosity (chemical activation). These materials are more versatile in adsorption efficiency and capacity. The AquaSorb™ PICABIOL2® series consists of biological activated carbon (BAC), which offers extraordinary extension of operating life.

The Production Company



Our dedicated lab technicians have developed over 2,400 product specifications to date.



Custom tailored activated carbon solutions is our specialty.



Production facilities in Asia, Europe and the USA mean rapid order fulfilment.

JACOBI IS ONE of the world's largest manufacturers of activated carbons. From our wide array of raw material sources we can select exactly the correct activated carbon for optimum result in the field of

water treatment. Our customer-focused approach has resulted in more than 2,400 product specifications, many are created to reflect individual customer requirements.

Through our in-house laboratory, process engineering and technical assistance we provide a refreshing approach to the market. Their knowledge is available for on-site or remote consultation on optimization of existing systems or new plant design. Jacobi also has the most up-to-date software for modelling process dynamics, and our extensive library of isotherms and operational data provides a rapid access to industry leading know-how and best practice.

All markets are served in a highly cost-effective manner through production facilities in Asia, Europe and the USA. Our extensive network of sales people is committed to fulfil our customers' needs, before and after the sale. Recycling centres are strategically positioned to serve the key markets where regeneration of activated carbon is a key part of the water treatment process.



Recycled or regenerated activated carbon can be a cost effective answer.



Optimization of existing systems or new plant designs – our consultants have the answers you need.

FAQ's

What information is required for product recommendation?

To recommend the best product and grain size, and design a granular activated carbon filter to achieve the targeted performance, Jacobi experts will require information regarding:

- Origin and final use of the effluent to treat
- Nature, concentration, physical and chemical characteristics of the molecules to adsorb and the other parameters of the effluent
- Description of the treatment line
- Design and operating conditions
- E-removal efficiency



What kind of tests are performed to differentiate products?

Selection of activated carbons should be ideally performed after tests in "real" conditions, for example by jar-test for PAC, or dynamic trials for GAC. Otherwise, the choice relies on the quality parameters of activated

carbons. A relevant parameter is the function of the exact application of activated carbons. For example, for pesticides removal, the iodine number is a reliable parameter, while molasses is more representative of organic matter adsorption.

When is powdered activated carbon used?

Powdered activated carbon (PAC) is preferably used in the case of temporary (seasonal or accidental) pollution in plants equipped with a separation step (coagulation-sedimentation, ultrafiltration etc). It can be implemented immediately, and is conventionally injected as a slurry at the very beginning of the treatment line to treat raw water. But processes using PAC continuously for the polishing of water are also developing. After use and separation from water, PAC needs to be disposed of. PAC and GAC can be implemented at the same plant. PAC will protect GAC from peak loads of pollution.

How does granular activated carbon work?

Granular activated carbon (GAC) is meant to treat both continuous and temporary pollution of water, generally as the last polishing step of the plant. It is installed in filters (gravity or pressurized) and operated for a long period of time, generally several years. Once GAC is saturated, it must be reactivated or replaced. When PAC and GAC are implemented in the same plant, PAC will protect GAC from peak loads of pollution.

What needs to be done before putting GAC into operation?

In order to neutralize granular activated carbons and remove the intrinsic dust, standard GACs need to undergo a complete commissioning operation including a soaking phase for 24–48 hours, air scouring and backwashing. Jacobi also offers pre-conditioned GACs that have been soaked, neutralized and de-dusted, which allows a much quicker start-up.

What is the benefit of using several filters in series or parallel?

Several filters installed in series or parallel increase the contact time, and, as a consequence, the removal efficiency. In series enhances safety and increases the effluent treatment efficiency, as the second filter will ensure final polishing. Once the first filter is saturated, it is replaced by the second filter and a new filter is installed for the polishing. This minimizes interruption of the operation.



How much carbon needs to be put online?

This will depend greatly on the application of interest. The key design parameter used in the drinking water and beverage industries is Empty Bed Contact Time (EBCT), which is simply measured by dividing the volume of the carbon bed by the liquid flow rate. EBCT's for water applications are typically 3–5 minutes for dechlorination, 7–10 minutes for chloramine removal (which can be reduced to 3–5 minutes if catalytic carbons such as AquaSorb™ CX-MCA are used), and 10–15 minutes for organic compounds.

How can a carbon bed be disinfected if biological growth occurs in the bed?

Disinfection of carbon beds is a challenge, as typical disinfectants used on other equipment and media (e.g. chlorine, permanganate) will react with the carbon, and organic biocides will adsorb onto the carbon. The most

common methods for disinfection include washing the bed with hot water (above 80 °C), steaming the bed (if the materials of construction of the adsorption system permit it), or washing the bed with caustic. Jacobi can provide more detailed procedures if required.

How long does granular activated carbons last?

Granular activated carbon life can vary from a few months to more than 8 years. It relies on four main factors:

- Nature, concentration, physical and chemical characteristics of the molecule to adsorb and other molecules present in water
- Choice of activated carbons
- Design and operating conditions
- Expected removal efficiency

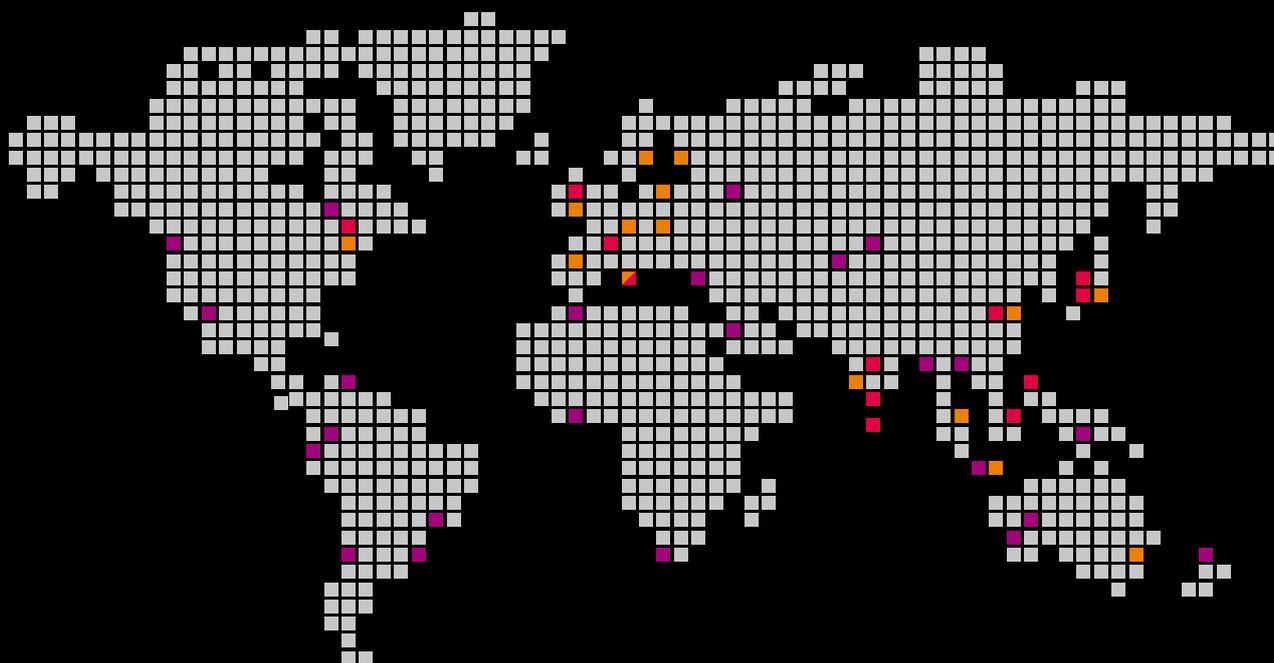
When is it time to reactivate or replace activated carbon?

When the activated carbon no longer meets the treatment objectives, it must be replaced or reactivated. To make sure that the spent GAC complies with our reactivation acceptance criteria, the usage time can be limited so that the reactivated GAC quality will be close to the virgin GAC quality. Jacobi provides annual analytical follow-up of GAC during operation to help customers make the right decision at the correct time.



The Global Company

Jacobi Carbons has developed the most diverse production base in the industry with manufacturing plants, reactivation plants and sales offices located in 19 countries around the world.



MANUFACTURING PLANTS

China
France
Germany
India
Italy
Japan
Sri Lanka

The Philippines
United Kingdom
United States
Vietnam

SALES OFFICES

Australia
China
Finland
France
Germany
India
Italy
Japan
Malaysia

Poland
Singapore
Spain
Sweden
Switzerland
United Kingdom
United States

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South Africa
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Uzbekistan

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A PROUD MEMBER OF THE
OSAKA GAS CHEMICALS GROUP