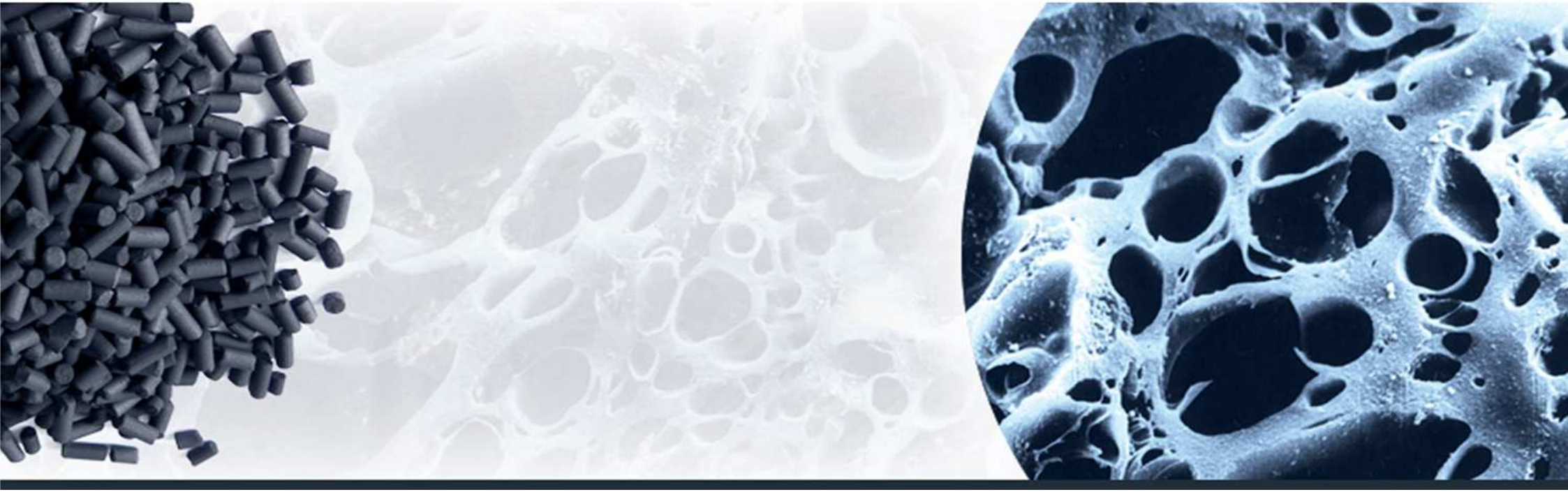
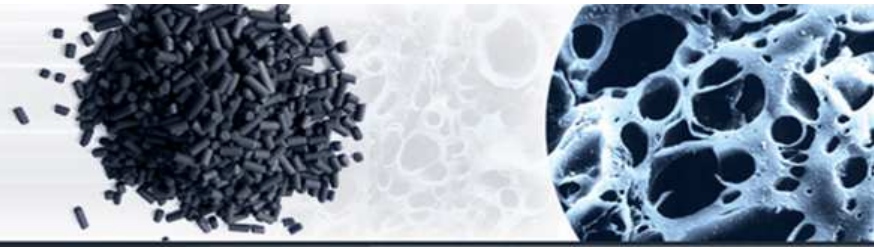


Business Unit Donau Carbon
Donau Chemie Gruppe

Product Training by Technical Department

09th of September 2015



Agenda

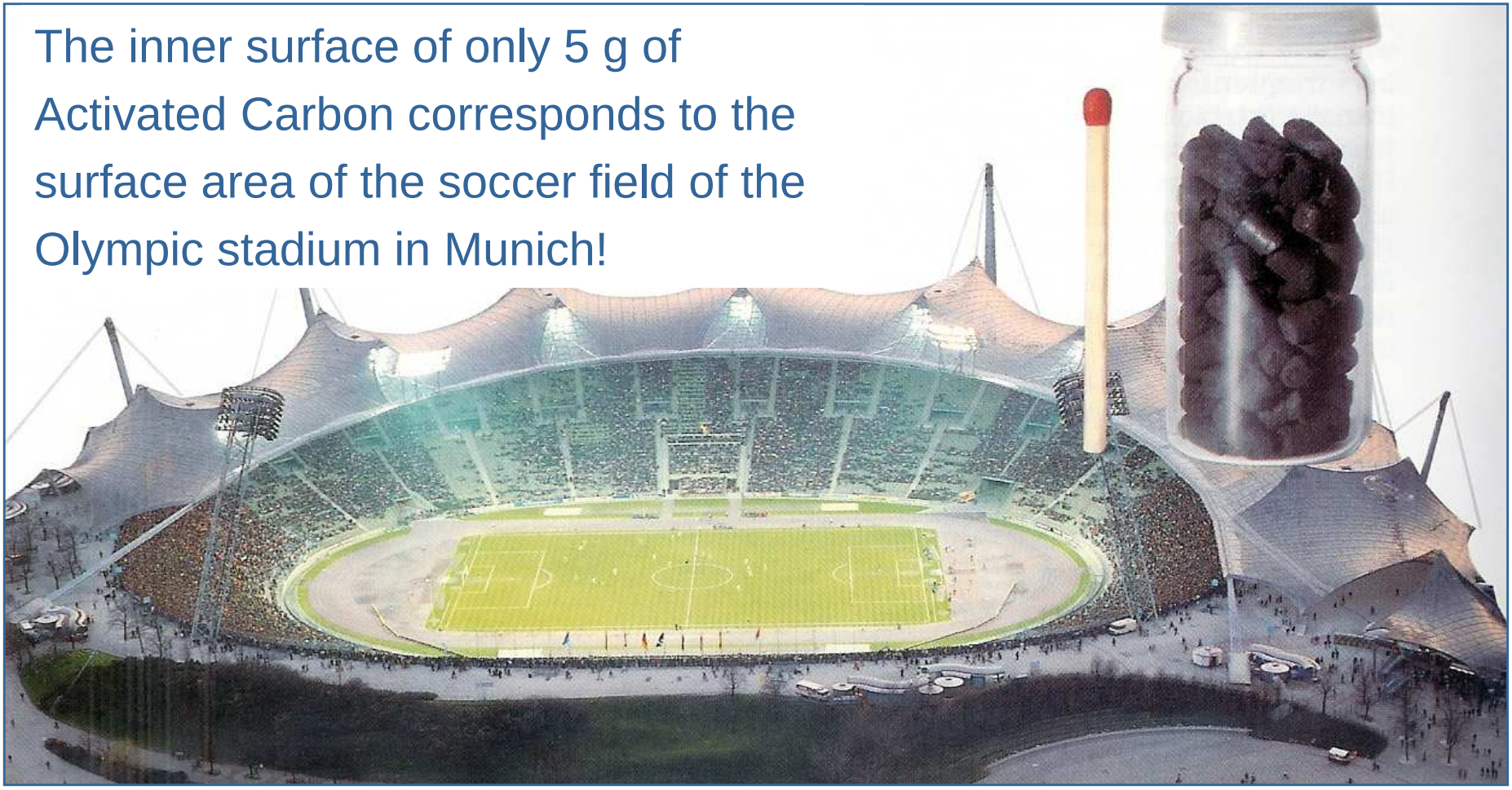
- Activated carbon – a brief introduction - NRT
  - Producing of Activated Carbon - Raw Material & Manufacturing
  - Appearance of activated carbon & Pore Structure
  - Basics on Adsorption
- Activated carbon applications & products - BLO
  - Water Treatment → Hydraffin
  - Liquid Treatment for Chemical/Food/Pharma → Carbopal & Epibon
  - Air & Gas Treatment → Desorex & Supersorbon
  - Special Applications → Alcarbon
- Sales Support by Technical Department of Donau Carbon - MMA
  - Selection of Activated Carbon (Parameters) for different Applications
  - Laboratory Services - R&D - Certifications
  - Questionnaires, technical bulletins for concrete cases
  - Technical Calculations
- Questions & Discussion

Agenda

- Activated carbon – a brief introduction
  - Producing of Activated Carbon - Raw Material & Manufacturing
  - Appearance of activated carbon & Pore Structure
  - Basics on Adsorption
- Activated carbon applications & products
  - Water Treatment → Hydraffin
  - Liquid Treatment for Chemical/Food/Pharma → Carbopal & Epibon
  - Air & Gas Treatment → Desorex & Supersorbon
  - Special Applications → Alcarbon
- Sales Support by Technical Department of Donau Carbon
  - Selection of Activated Carbon (Parameters) for different Applications
  - Laboratory Services - R&D - Certifications
  - Questionnaires, technical bulletins for concrete cases
  - Technical Calculations
- Questions & Discussion

Activated Carbon – High Performance and Invisible Efficiency

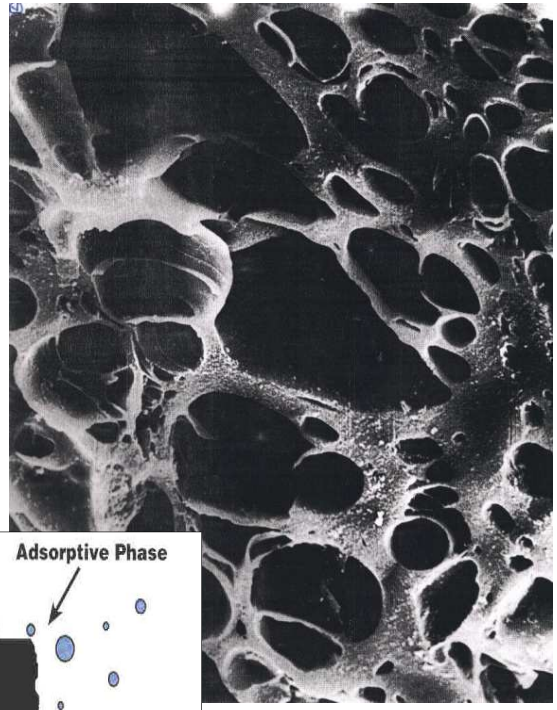
The inner surface of only 5 g of Activated Carbon corresponds to the surface area of the soccer field of the Olympic stadium in Munich!



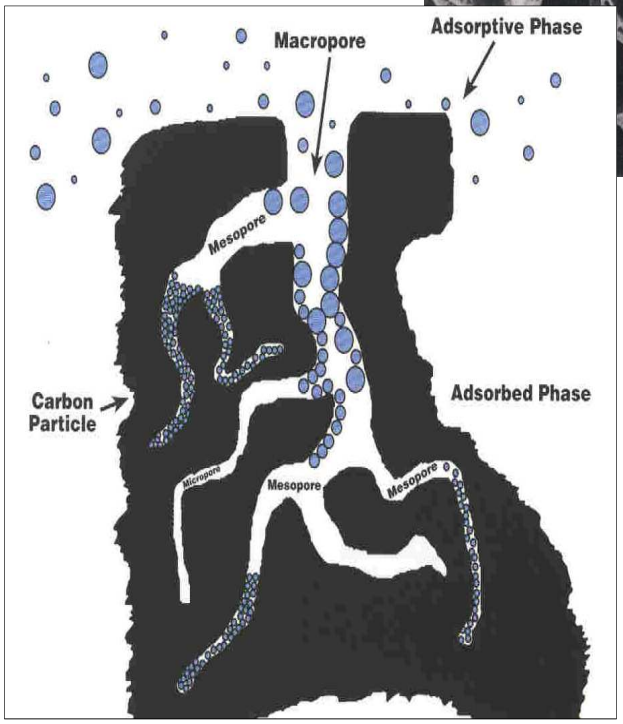
Activated Carbon - Definition

Activated Carbon is a porous adsorbent material presenting a large interior surface area in a range of 600 to 1,500 m^2/g

which allows the adsorption of a great number of substances from gaseous or liquid phases.

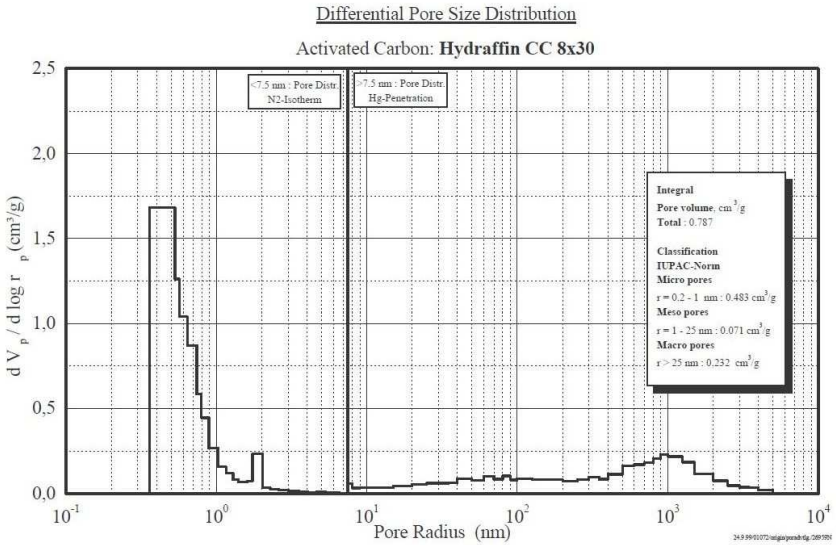


activated carbon recorded by scanning electron microscope

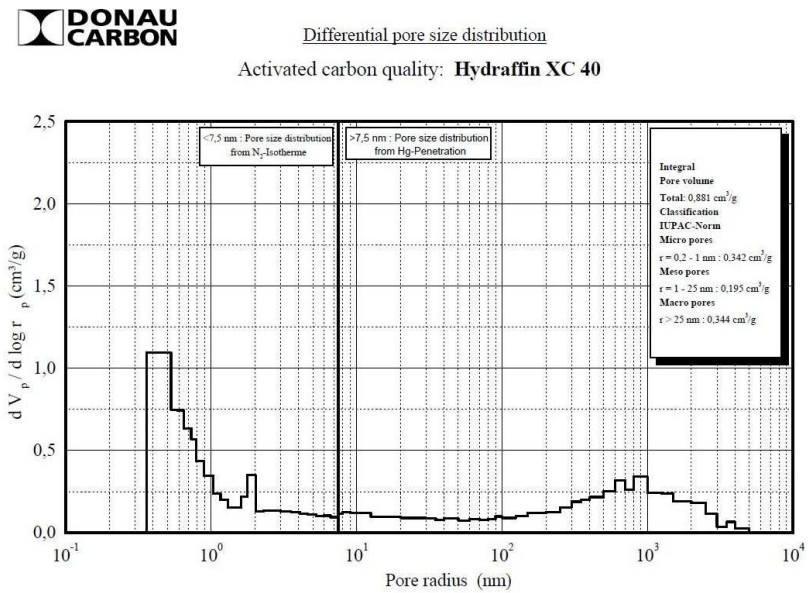


Activated Carbon and its Application – Raw material

- Coal
- Lignite
- Wood
- Coconut shells
- Fruit stones (e.g. Olive core)
- Peat
- Polymeres
- others



Cocosnut shell acrbon



Coal base carbon

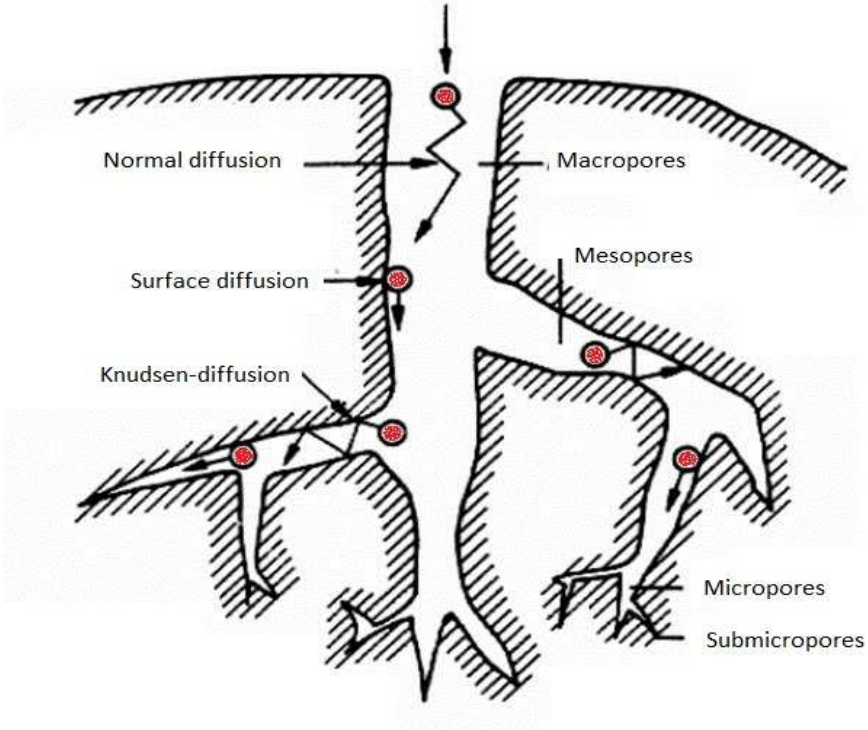
Characteristic of activated carbon

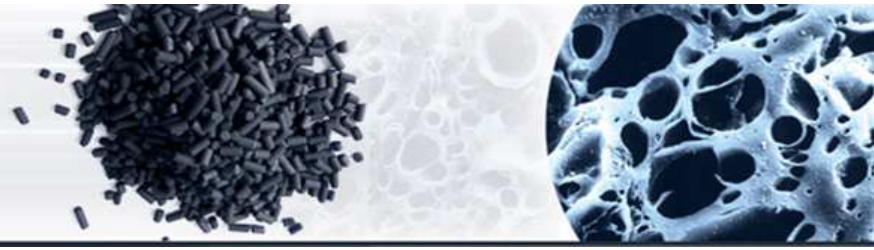
Not all pores are equivalent

- some pores allow good molecule transport
- some pores offer “parking” places for the adsorptive

Classification of pore size after IUPAC

Micro pores	< 1nm
Meso pores	1 - 25 nm
Macro pores	> 25 nm





Activated Carbon - Manufacturing

Gas activation process

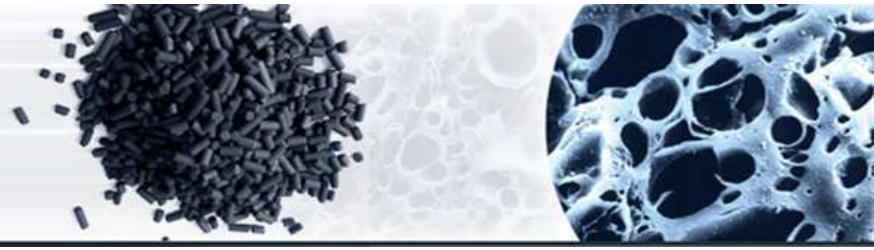
previously carbonised material is subjected to the oxidising action of gas, such as steam, carbon dioxide, air or mixture of these.

Activation temperatures typically range from 700 to 1.000 °C

$$C + H_2O \quad \text{---------->} \quad CO + H_2$$

$$C + 2\,H_2O \quad \text{---------->} \quad CO_2 + 2H_2$$

$$C + CO_2 \quad \text{---------->} \quad 2\,CO$$



Activated Carbon - Manufacturing

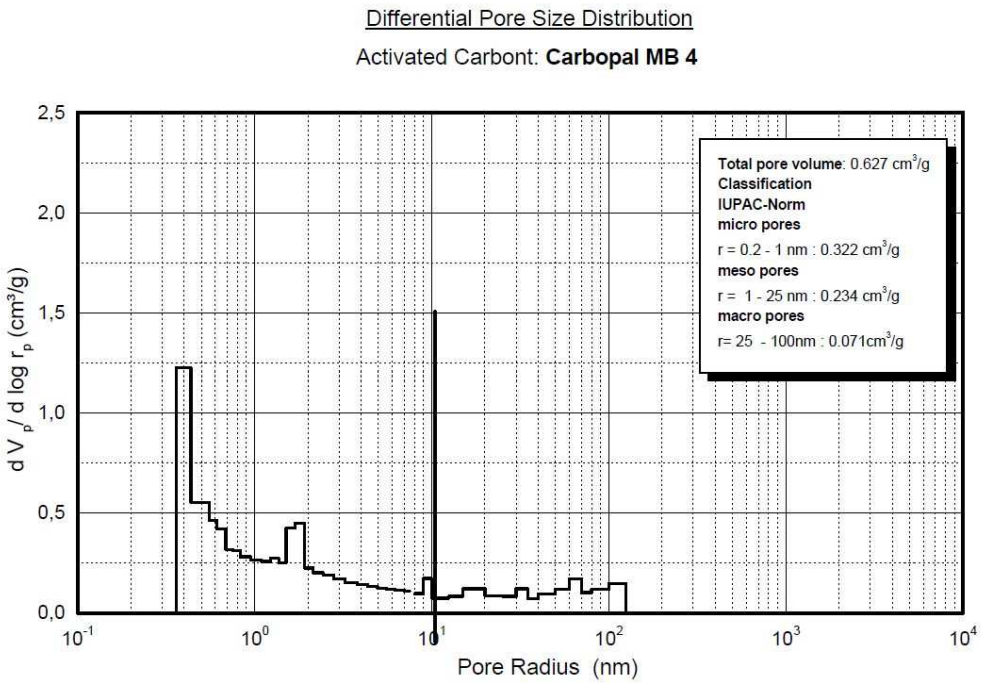
Chemical Activation Process

non-incinerated carbonaceous material such as saw dust is initially mixed with dehydrating or oxidising chemicals like zinc chloride or phosphoric acid and heated up to between 400 - 800 °C under exclusion of oxygen.

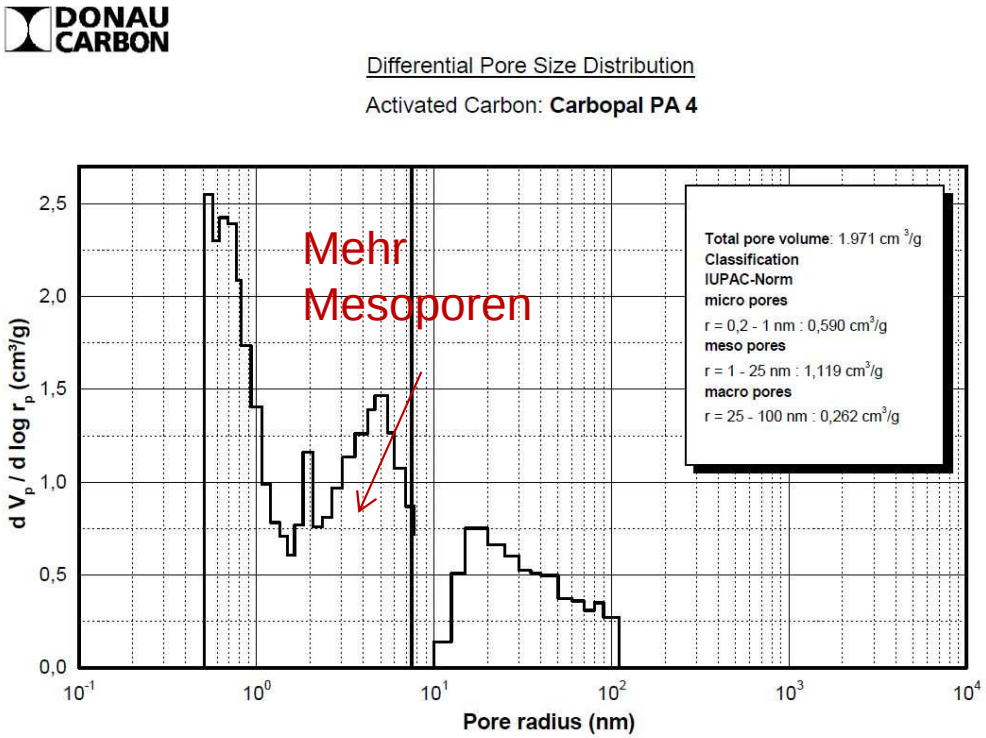
The activation agent is reached out recovered.

2 Types:
- Zinc chloride activation
- Phosphoric acid activation

Differentielle Porenradien Verteilung



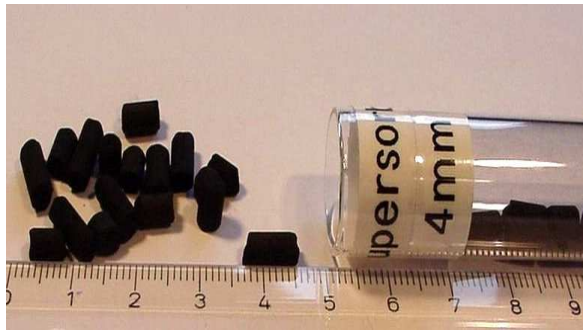
Steam activated



Chemical activated

AC - Product Forms

extruded



Typically 2, 3, 4 mm diameter pellets

(mainly used for air and gas applications because of lower pressure drop, in fixed bed filter)

granular

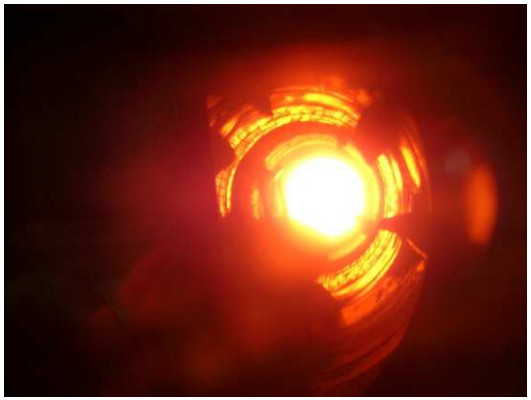


Grain size expressed in US. ASTM mesh
8x30 mesh (0,60 - 2,36 mm)
12x40 mesh (0,425 - 1,70 mm)
(Typically used in water and liquid treatment in fixed bed filter)

powdered



Typically around 1 - 150 µm
with 70% < 40 µm
(Used batchwise for water and liquid treatment or for flue gas cleaning)



Production steps

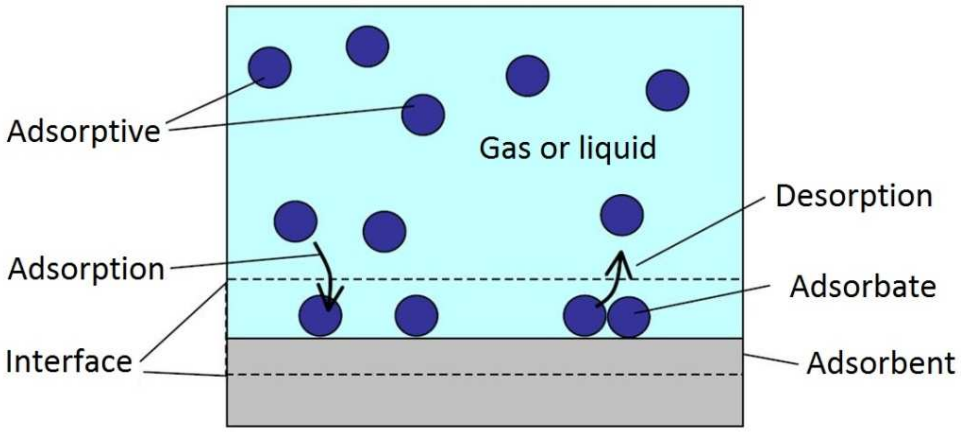
DONAU CARBON

Principles of Adsorption

- Adsorption is not caused by a chemical binding, but by
  - ⇒ electrodynamic interaction
  - ⇒ electrostatic interaction

  Adsorption is also called as physisorption.
- Example for adsorption:
  - ⇒ Adsorption of dissolved (in water) organic substances onto activated carbon.





DONAU CARBON

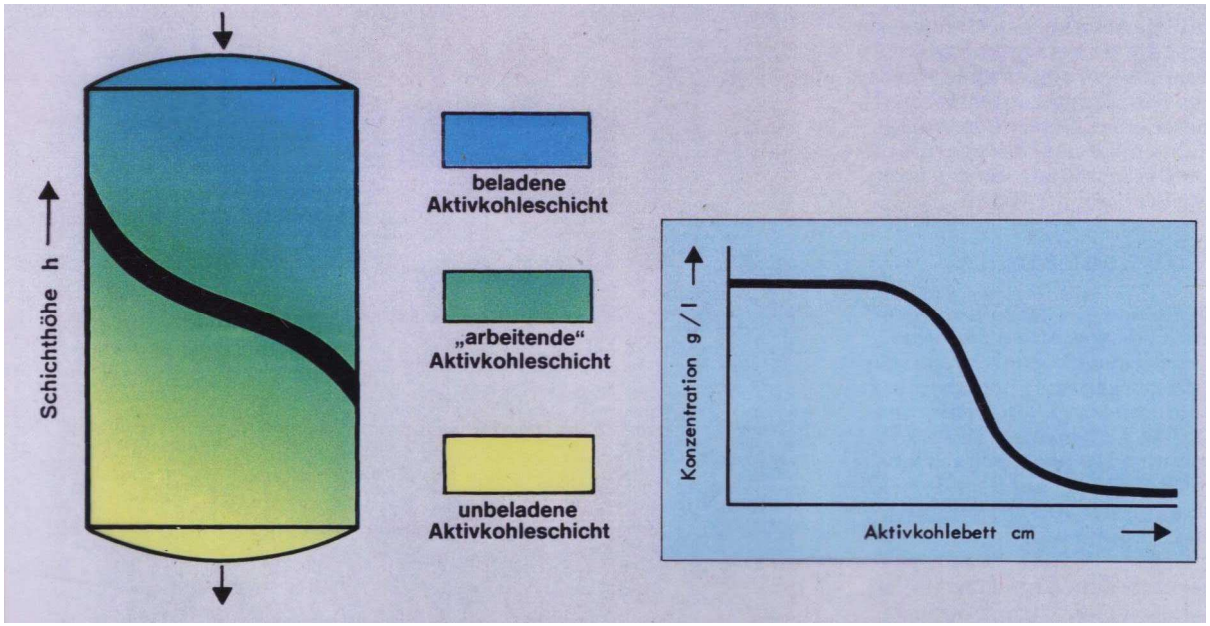
Adsorption on Activated Carbon

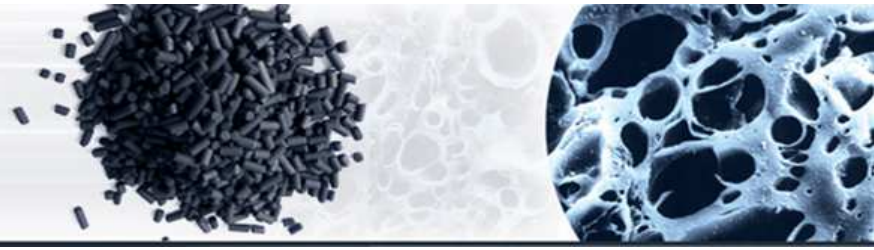
Adsorption capacity - Degree of adsorbate accumulation on activated carbon

Adsorption equilibrium - Balance between the adsorbate concentration in the liquid or gaseous medium and the concentration on the adsorbent

Adsorption zone –

the concentration gradient that is formed along a layer of activated carbon during the adsorption process



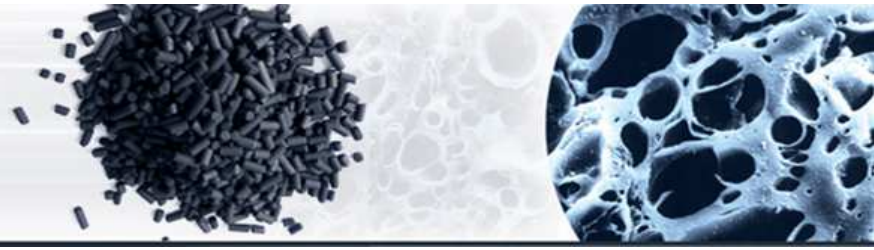


Adsorption Kinetics - Rate of adsorption

⇒ Time for the diffusion of the organic molecules from the bulk solution onto the external surface of the activated carbon:
⇒ External mass transfer

⇒ Time for the diffusion of the organic molecules from the external surface into the pore system of the activated carbon to the adsorption sites:
⇒ Internal mass transfer

Depending on the properties of activated carbon, the physical and chemical attributes of the adsorbate (substance to be adsorbed), the properties of the ambient gas or liquid phase and a number of process related parameters.

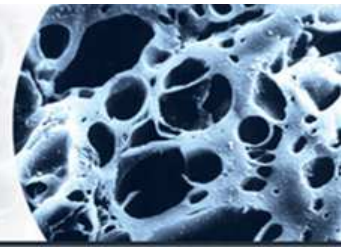


Factors influencing adsorption

- Chemical molecular characteristics, molecule size, hydrophilic behaviour, polarity of the substances to be adsorbed
- Solute adsorbate concentration, temperature, composition of the solution on gas mixture, pH-value of the solution during adsorption in the liquid phase relative humidity during adsorption in the gas phase
- Characteristic of the activated carbon - the size of interior surface area, pore structure, chemical properties and the surface characteristic

DONAU CARBON





Adsorption on Activated Carbon

Desorption - Reverse adsorption (Regeneration), e.g. in solvent recovery processes with steam or heat gas.

Chemisorption - Chemical reaction between impregnation on activated carbon and substances which are not good to adsorb

e.g. Potassium iodid impregnated carbon Desorex K 43 J:

$$H_2S + \tfrac{1}{2} O_2 \xrightarrow{\text{cataly.KI impregnated carbon}} S + H_2O$$

Agenda

- Activated carbon – a brief introduction
  - Producing of Activated Carbon - Raw Material & Manufacturing
  - Appearance of activated carbon & Pore Structure
  - Basics on Adsorption
- Activated carbon applications & products
  - Water Treatment → Hydraffin
  - Liquid Treatment for Chemical/Food/Pharma → Carbopal & Epibon
  - Air & Gas Treatment → Desorex & Supersorbon
  - Special Applications → Alcarbon
- Sales Support by Technical Department of Donau Carbon
  - Selection of Activated Carbon (Parameters) for different Applications
  - Laboratory Services - R&D - Certifications
  - Questionnaires, technical bulletins for concrete cases
  - Technical Calculations
- Questions & Discussion

Application – Water Treatment

HYDRAFFIN® types are used for water treatment, for example to treat:

- Drinking water
- Ground water
- Waste water
- Service water
- Landfill seepage
- Condensate and contact water
- Swimming pool water
- Aquarium water



Application – Water Treatment

Potable water

Removal of organic impurities, Dechlorination, removal of ozone and odour, removal of micro pollutants.

Granular activated carbon for fixed bed filters

Hydraffin CC 8x30 (coconut shell base)

Hydraffin XC 30 (open porous, coal base, high quality product)

Hydraffin 30 N (coal base)



Fixed bed filter

Powdered activated carbon for dosing batch wise

Hydraffin P 800 (coal base)

Carbopal MB 4 (wood base)

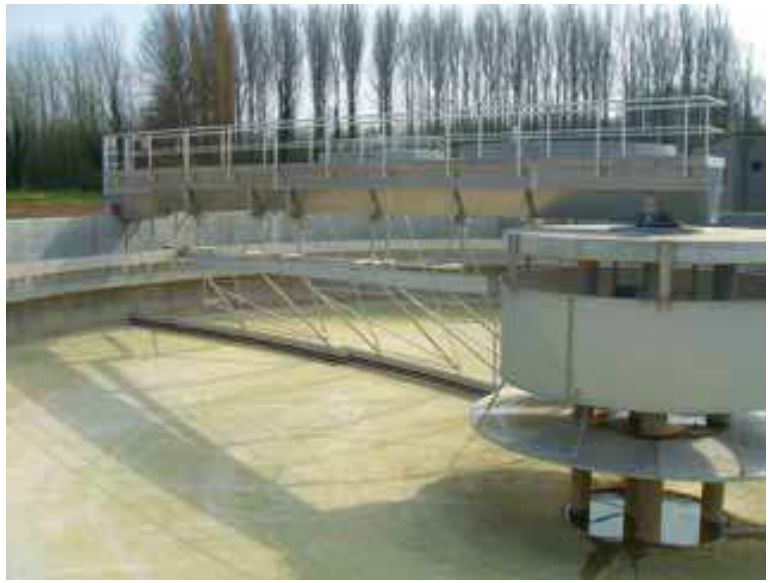
Carbopal CCP 90 (coconut shell base)



Utilization in parallel or serial array

Application – Water Treatment

Waste water / Ground water treatment
Removal of organic impurities



Granular Activated carbon for fix bed filters

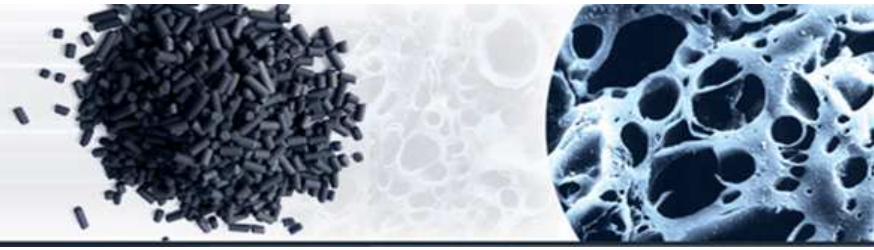
Hydraffin 30 N

Hydraffin WR or Hydraffin 30 N II

Powdered activated carbon for batch wise dosing

Hydraffin P 800 (coal base)

Carbopal AP (lignite, removal of colour and micro pollutants)



Application – PAC or GAC

Selection of activated carbon form – Overview of advantages	
Powdered activated carbon (Carbopal types)	**Granular activated carbon (Epibon, Alcarbon and Hydraffin types)**
Low invest cost	Possibility of environment-friendly & cost-saving reactivation
Temporary usage possible	Compensation of concentration fluctuations
No preloading	Use as security level
Low space needed	Low analytical effort
Multiple use	Easy handling

Applications – Food and Beverage Industry

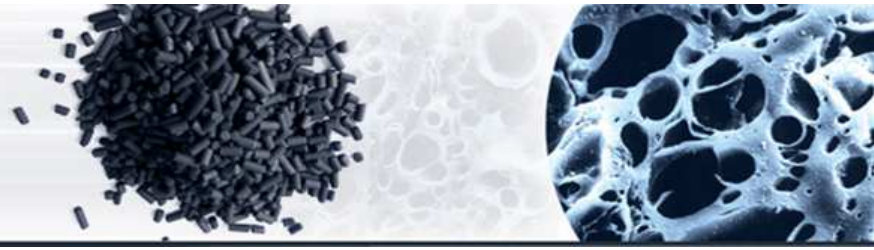
Tasks (AC meets requirement of Food Chemical Codex):

- Treatment of product
  - Odour and taste adjustment (steam activated AC)
  - Decolourization (chemical activated AC)
  - Removal of other substances (steam/chemical activ. AC)
- Treatment of potable water for beverages
  - Dechlorination (granular, steam activated AC)



Properties of suitable activated carbon :

- High purity
- Defined particle size distribution
- Defined pH value
- High performance, evaluated by molasses or methylene blue number
- For granulated carbon – high mechanical resistance (reactivation)



Applications – Food and Beverage Industry

Sugar solutions (neutralized carbon required):

- Carbopal PA4 N and Carbopal Gn-AZ (wood based, powdered)
- Epibon Y 12x40 spezial (granular, reactivation possible)

Glucose / starch (pH-adjusted carbon required):

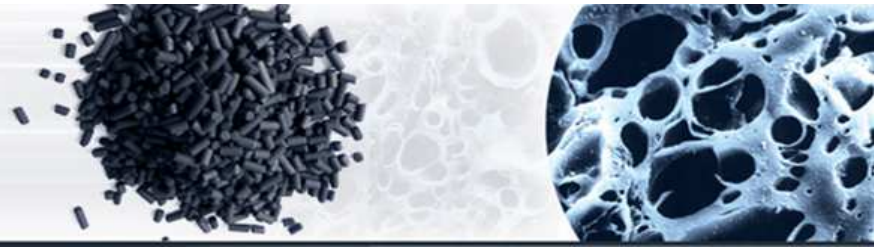
- Carbopal Gn-P, Gn-A II and Carbopal MB 4S (wood based, powdered)
- Epibon Y 12x40 spezial (coal based, granular, reactivation possible)

Wine (pH-adjusted carbon required): (both wood based, powdered)

- Carbopal Gn-P (decolourization)
- Carbopal MB 6 SB 30 (taste regulation)

Beer and soft drinks (for water treatment):

- Hydraffin CC 12x40 (coconut shell based, granular, reactivation possible)



Applications – Food and Beverage Industry

Apple juice (patuline removal):

- Carbopal CCP 90 (powdered, coconut shell based carbon)

Soup spice mixes and Glutamate (decolourization):

- Carbopal Gn-P and Gn-A II (wood based, powdered)

Alcohol treatment (odour and taste adjustment):

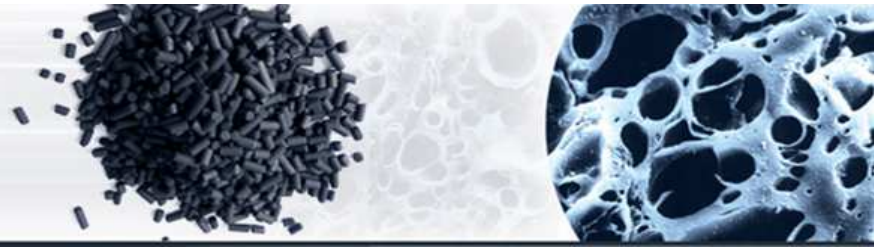
- Hydraffin CC 12x40 (coconut shell based, granular, reactivation possible)

Vegetable oil treatment (PAH removal):

- Carbopal ACP (powdered, steam activated carbon)

Citric acid (decolourization):

- Epibon Y 12x40 (coal based, granular, reactivation possible)



Applications – Chemical Industry

Tasks

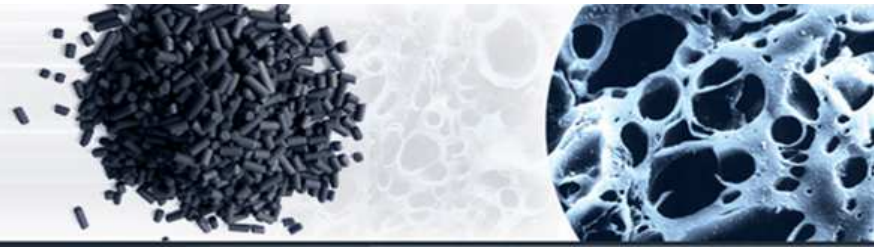
- **Treatment of product**
  - Removal of impurities and undesirable by-products
  - Decolourization

- **Waste gas cleaning**

- **Waste water treatment**

Complete solutions:

Activated carbon in filter systems



Applications – Chemical Industry

Glycerine treatment (decolourization and odour removal):

- Epibon Y 12 x40 (coal base, granular, reactivation possible)

Oil- and gas industry:

- Desorex K 43 J / Oxorbon K40 J (H_2S-removal, Iodine impregnated carbon)
- Hydraffin 30 N (Treatment of amine solution)
- Desorex HGD 4 S (sulphur impregnated for mercury removal)

Galvanic bathes (cleaning and decolourization):

- Hydraffin P 800 and Carbopal MB 4 (steam activated, powdered AC)

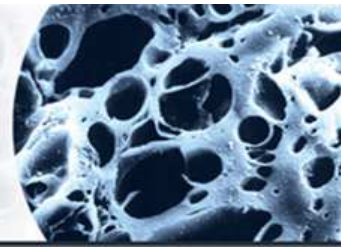
Waste gas treatment (basic + possible impregnations)

- Desorex K 47

Waste water treatment (basic/broadband)

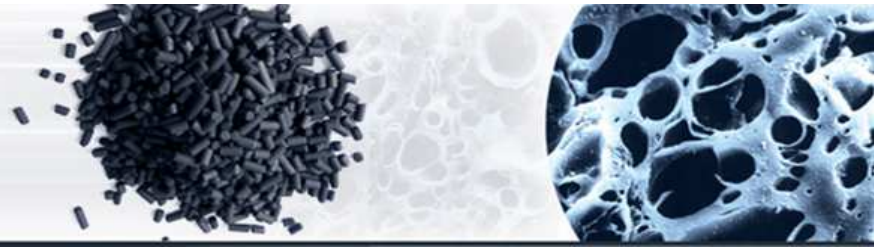
- Hydraffin 30 N or P 800 (coal based, steam activated)





Applications – Chemical Industry

Activated carbon used for chemical treatment:		
Application/ to be treated media	**Task / substance to be removed**	**Recommended activated carbon**
Phosphoric acid	Removal of humid acids	Epibon Y 12 x 40 spezial / Epibon X 12 x 40 spezial
Hydrochloric acid	Removal of chlorobenzene	Hydraffin CC 12 x 40 spezial
Adipic acid	Removal of cyclopentanone	Epibon Y 12 x 40 spezial
Natural resins, e.g. shellac	Decolourization by removal of erythromycin	Epibon Y 12 x 40
Amino acid, e.g. methionine & cysteine	Decolourization	Epibon Y 12 x 40 spezial Epibon Y 12 x 40 LC Carbopal PA 4N
Glycerine	Decolourization and deodorization	Epibon Y 12 x 40 Hydraffin CC 12 x 40
Parabens	Decolourization	Epibon Y 12 x 40 spezial
Pentaerythritol	Decolourization	Hydraffin P 800
Amine purification	Removal of organic compounds	Hydraffin 30N
Diammonium hydrogen phosphate	Removal of BTEX	Epibon Y 8 x 30 spezial
Bates, caustic solutions and galvanic baths	Reduction of COD-concentration	Hydraffin 30 N Hydraffin MB 4 oder P 800

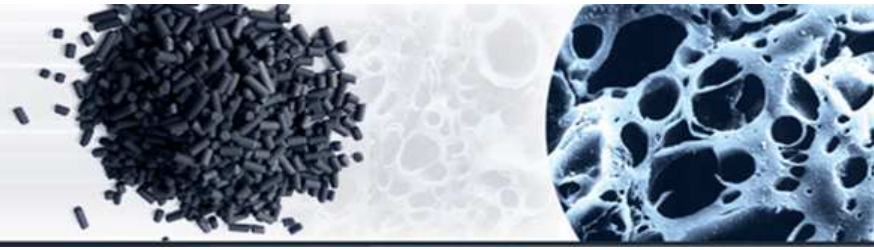


Global Player in the Chemical Industry

Delivery of DC qualities for different production sides and tasks

- **Production of softening agent** – Hydraffin P 800 – 35 t p.a.
- **Waste incineration plant** – Carbopal CCM 80 FF – 80 t p.a.
- **Off gas cleaning** – Desorex K 43 – 35 t p.a.
- **Solvent purification** – Epibon Y 12x40 – 80 t p.a.
- **Purine cleaning** – Hydraffin P800 – 300 t p.a.
- **Decolourization of polymer solution** – Carbopal PA 4 – 20 t p.a.

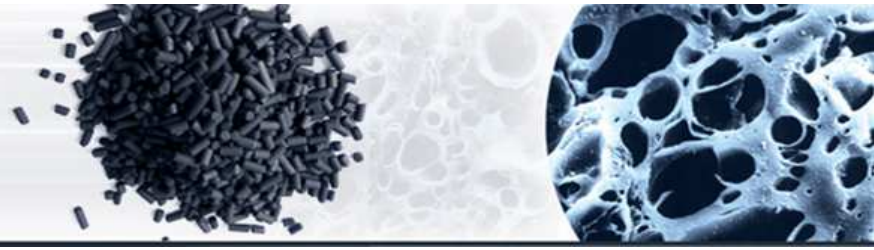
… and many more



Applications – Pharmaceutical industry

Tasks:

- **Removal of impurities (odour and colour)**
- **Production:**
  - Proteins – removal of amino acids, blood plasma
  - Enzymes – for pharmaceutical quality (Amylase, Glucose)
  - Pain reliever
  - Contrast medium
- **Waste water treatment**



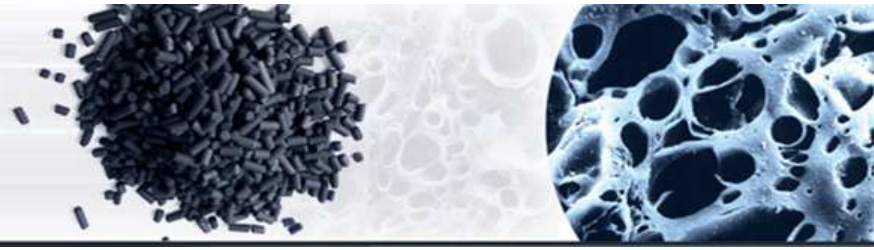
Applications – Pharmaceutical industry

Properties of suitable activated carbon:

- High purity
- Defined particle size distribution
- Defined pH-value
- High performance, evaluated by molasses or methylene blue number

Recommended types from DC can meet:

- Pharmacopoea Europaea (Ph. Eur.) 7.0/8.0
- US Food and Chemicals Codex (FCC) VIII. 2013/ 9th Ed. 2015



Applications – Pharmaceutical industry

Suitable activated carbon types:

Activation	High Pure (FCC)	Pharma Grade (Ph. EUR)	Application
H_3PO_4 - High	**Carbopal PA 4 (N)**	**Carbopal PA 4N PG**	medium colour - proteins
steam/washed HCl/H_20	**Carbopal SC 11 pur**	**Carbopal SC 11 PG***	odour - light colour

- Technical Data Sheet
- Certificate for FCC and Ph.Eur. compliance
- Certificate for microbiota tests from independent lab
- Samples to provide

Applications – Air and Gas Treatment

DESOREX® and SUPERSORBON® types have a wide range of uses in gas and exhaust air treatment applications:

- Solvent recovery
- Natural gas purification, removal of H_2S and BTX
- Flue gas cleaning at waste incineration plants
- Removal of dioxins, furans and mercury
- Purification of process gases
- Odour control
- Bio gas treatment



Applications – Air and Gas treatment

Use of DESOREX ® - types
(coal base carbon, extruded, 4 mm):

- Desorex K 47 F (CTC 40)
- Desorex K 47 (CTC 50)
- Desorex K 43 (CTC 60)



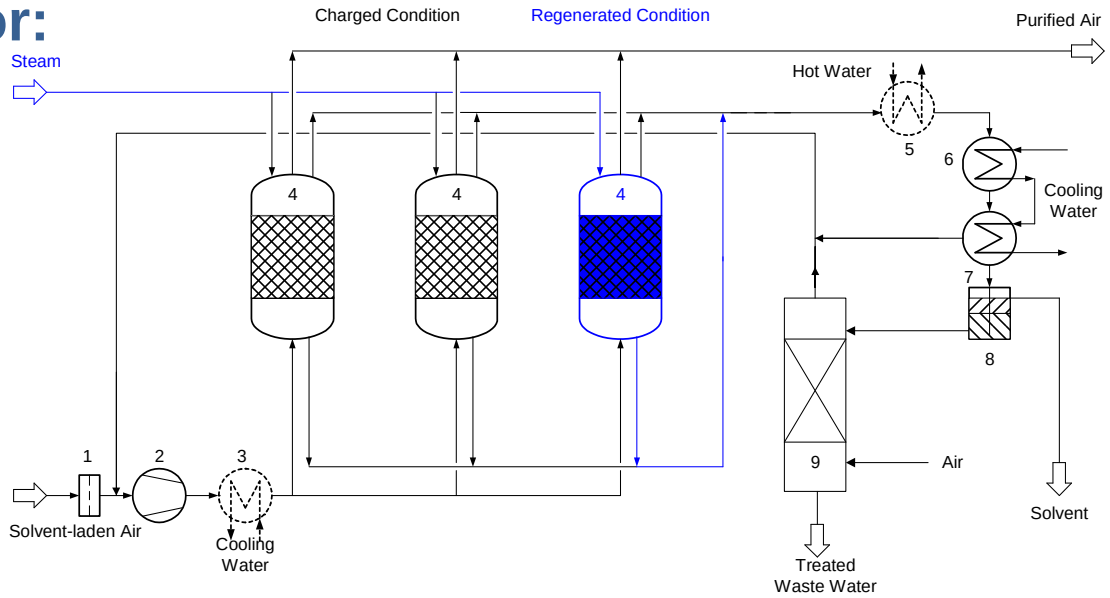
Advantages

- Good adsorption capacity
- Low pressure drop
- High hardness
- Can be reactivated (depending on loading)

Applications – Solvent Recovery

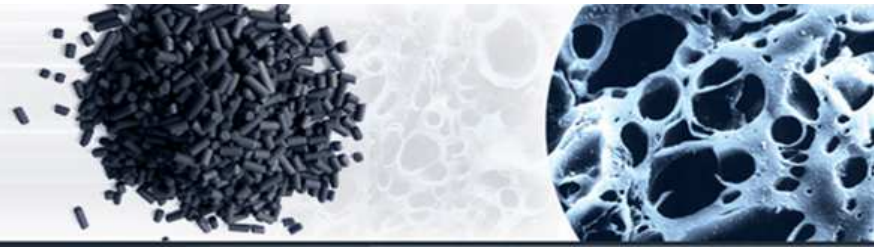
Use of SUPERSORBON® types for:

- Printing Industry
- Varnishes
- Packaging Industry



Removal of Solvents like toluene, ethyl acetate, alcohols etc.

- Supersorbon K 40 (4 mm coal base)
- Supersorbon K 42 (4 mm coal base, open porous)



Applications – Air and Gas treatment

Use of DESOREX®- types e.g. for

Odour control in sewage treatment plants

- Desorex PI 50 K (4 mm, coal base, catalytic, regeneration with water)

Biogas treatment

- Desorex K 43 BG (4 mm, coal base, alcaline impreg. for medium humidity gas)
- Desorex K 43 J (4 mm, coal base, iodide impreg. for low humidity gas, oxygen required)

Removal of Siloxanes

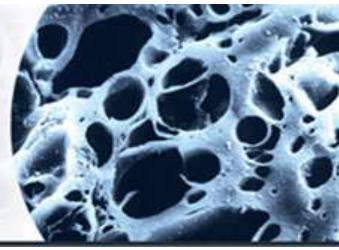
- Desorex K 47 (4 mm, coal base)

Mercury removal:

- Desorex HGD 4S (4 mm coal base, sulfur impregnated)

DONAU CARBON





Applications – Air and Gas treatment

Impregnated DESOREX®-types:

Impregnation level and base carbon can be tailor made

Impregnated activated carbon for the removal of different substances:

Desorex	Granulation Diameter (mm)	Impregnation	Substance
K 23 J K 43 J	2 4	potassium iodide	H_2S from oxygen enriched gases
K 33 Na K 43 Na	3 4	caustic soda	H_2S from low oxygen gases
K 33 A K 47 A	3 4	potassium carbonate	SO_2, HCl, NOXHS, acid gases
K 33 P K 47 P	3 4	phosphoric acid	NH_3, alkaline gases
K 33 S K 43 S	3 4	sulphuric acid	NH_3, alkaline gases, amines
HGD 2 S HGD 4 S	2 4	sulphur	Hg
Oxorbon K 20 J K 40 J	2-4	potassium iodide	H_2S from oxygen enriched gases
Oxorbon K 33 COS	3	metal impregnated	COS
Special grades	6 x 12 8 x 16	different impregnates	nuclear

Applications – Flue Gas treatment

Conditions

Gas temperature: 130 - 170°C

Mercury: 100 µg/m³

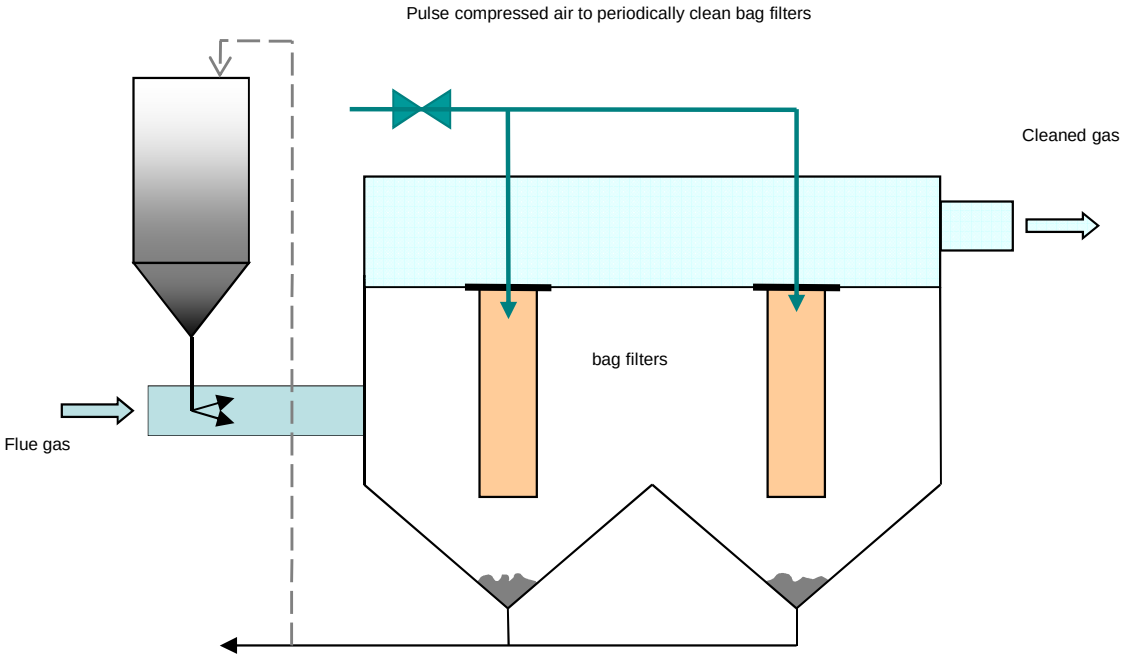
SO_2: approx. 1 g/m³

H_2O: 20 Vol.%

Achievable purity level of

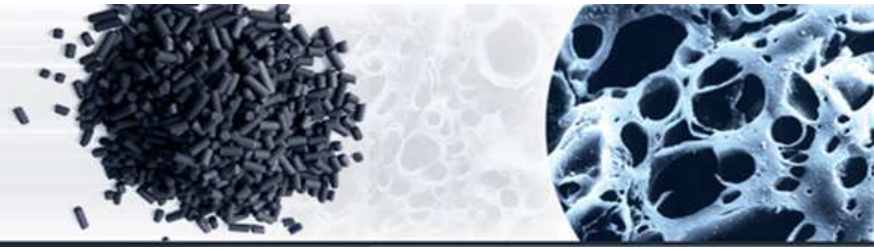
- Mercury: approx. 98%

- Dioxin: > 99%



Dioxin/Furan dry treatment

Dosage depending on application: 10 – 100 mg/Nm³



Applications – Flue Gas treatment

Recommended AC Qualities (steam activated)			
Type	**Hydraffin® PR Based on coal**	**Carbopal® CCM 70 (FF) Based on coconut**	**Carbopal® CCP 90 Based on coconut**
BET-Surface Area (m^2/g)	600	700	900 – 1000
Iodine number (mg/g)	500 – 600	650 – 750	1000 – 1100
Ash content (wt.%)	< 20	< 20	< 6
Water content (wt.%)	< 15	< 15	< 8
Fineness (µm)	20 – 35	20 – 35	20 – 35
Suitable for … of Dioxin/Furan, Mercury	Low concentrations	Normal concentrations	High concentrations

Special Applications

ALCARBON® types are used

- in gold industry
- for emission control
- in air conditioning systems, filters for clean rooms
- for pollutant removal in
  - cabin air ventilation systems
  - cigarette filters
  - drinking water filters

ALCARBON® qualities are available with different impregnation for special applications.

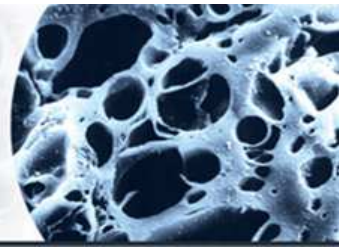


Agenda

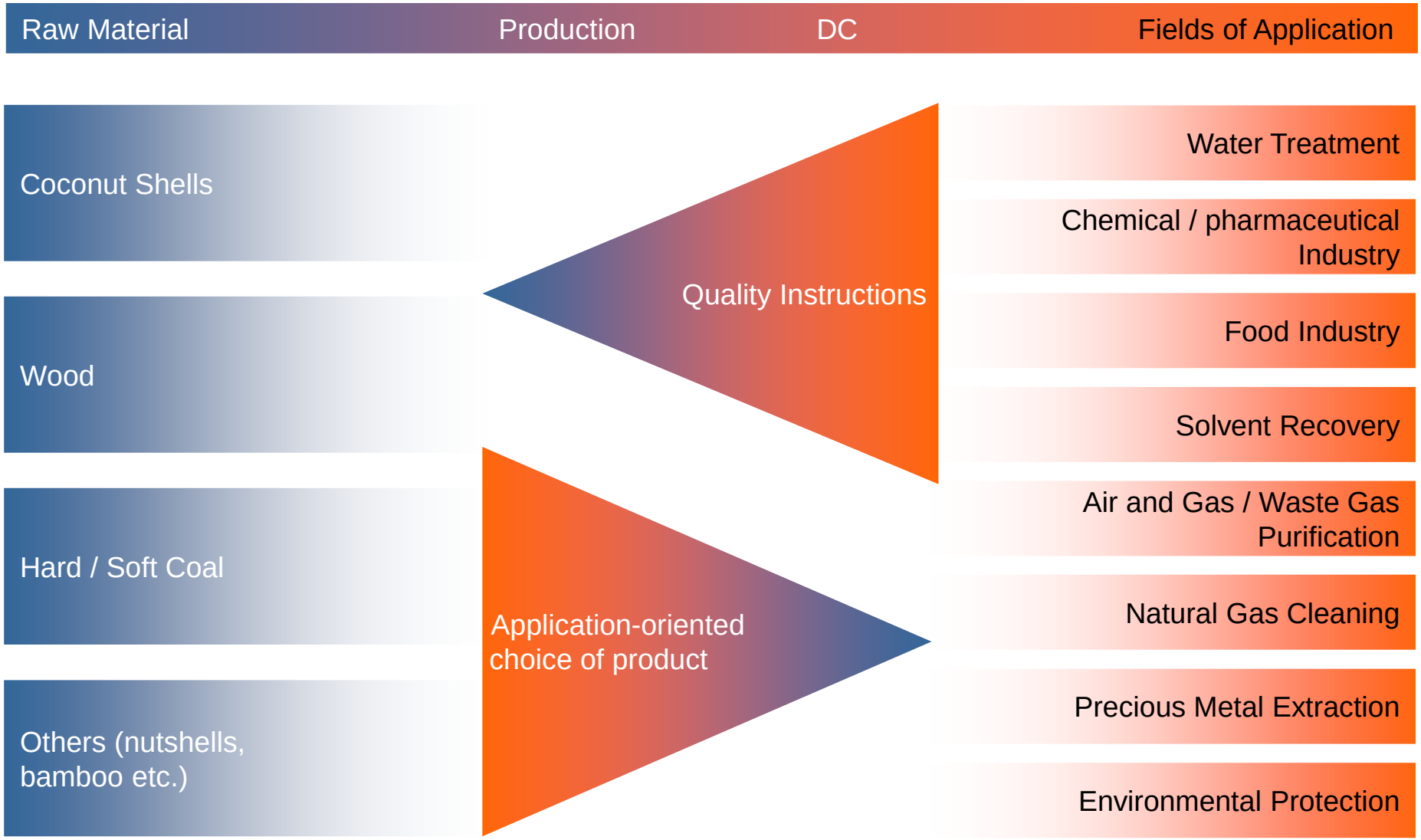
- Activated carbon – a brief introduction
  - Producing of Activated Carbon - Raw Material & Manufacturing
  - Appearance of activated carbon & Pore Structure
  - Basics on Adsorption
- Activated carbon applications & products
  - Water Treatment → Hydraffin
  - Liquid Treatment for Chemical/Food/Pharma → Carbopal & Epibon
  - Air & Gas Treatment → Desorex & Supersorbon
  - Special Applications → Alcarbon
- Sales Support by Technical Department of Donau Carbon
  - Selection of Activated Carbon (Parameters) for different Applications
  - Laboratory Services - R&D - Certifications
  - Questionnaires, technical bulletins for concrete cases
  - Technical Calculations
- Questions & Discussion

DONAU CARBON

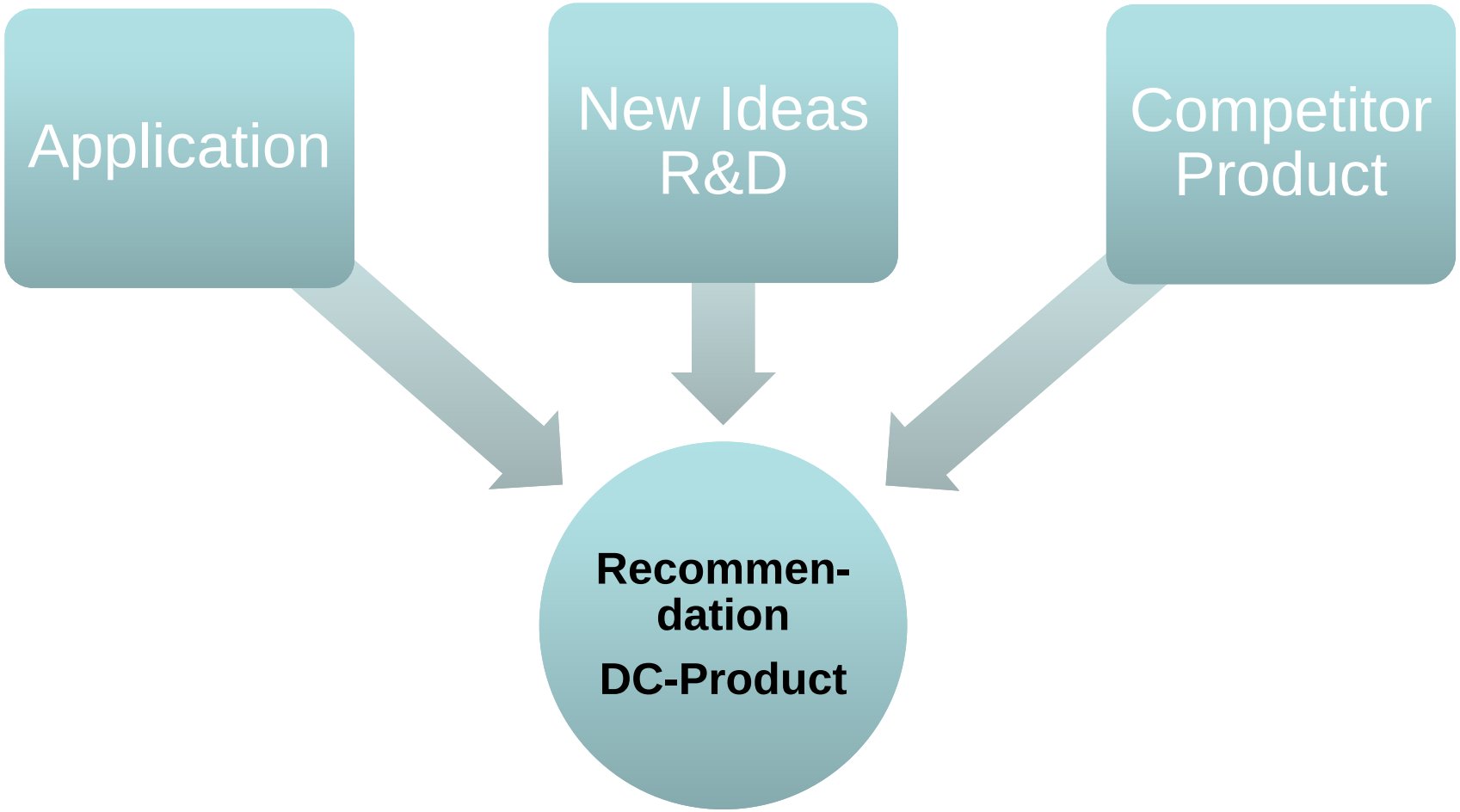




From Raw Material via Donau Carbon to AC-Application



Technical Department – Recommendation of DC-Products



Questionnaire



Questionnaire for activated carbon recommendation from Donau Carbon

Please fill in details below when available.

Client:

- **Application field:**

☐ Drink water ☐ Waste water ☐ Process water ☐ Ground water remediation ☐ other: _____

☐ Food industry ☐ Chemical ☐ Pharma ☐ other: _____

☐ Air treatment ☐ Biogas ☐ CO2 ☐ Gas / other: _____

- **Properties of the activated carbon:**

Raw material ☐ Coal based ☐ Coconut ☐ Wood ☐ other: _____

☐ Granulated carbon ☐ 8x30 mesh ☐ 12x40 mesh ☐ other: _____

☐ Powdered carbon (any special requirements about fineness?) _____

☐ Extruded carbon Diameter: ☐ 4 mm ☐ 3 mm ☐ other: _____

Name of the activated carbon currently in use: _____

- **Purpose / substances to be removed:**

☐ Purification ☐ Decolourization ☐ Dechlorination ☐ other: _____

☐ Solvents ☐ Sulfur removal ☐ Mercury removal ☐ other: _____

Impurities to be removed: _____

Concentration of those impurities: _____

- **Data about the process:**

Flow rate to be treated (gas or liquid): _____ m³/h

Quantity / Weight of the activated carbon bed: _____ in m³ or tons

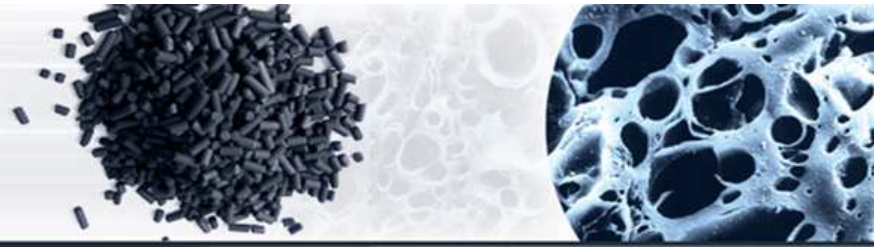
How many filters: ___ Diameter: ___ m Bed height: ____ m

Process: ☐ continuous ☐ discontinuous ☐ placed in parallel ☐ in lead-lag

Temperature: ____ °C pH-value: ____

For gas: relative humidity: ____ % Pression: ____ bar

Is reactivation of the saturated carbon wished? ☐ yes ☐ no



Activated Carbon Parameters for different Applications

The total surface area BET: 900 – 1200 (m^2/g)

does not reflect directly the adsorption efficiency

Water applications

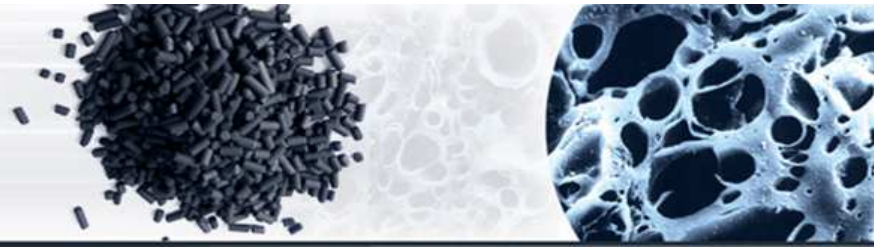
- Iodine number: 900 – 1200 (mg/g)

Decolourization / food, chemical, Pharma applications

- Molasses number: 0,4 – 2,7
- Methylene number: 10 – 19 (ml)

Gas applications

- CTC (Carbon Tetra Chloride) adsorption: 45 – 90 (% wt.)
- Butane working capacity



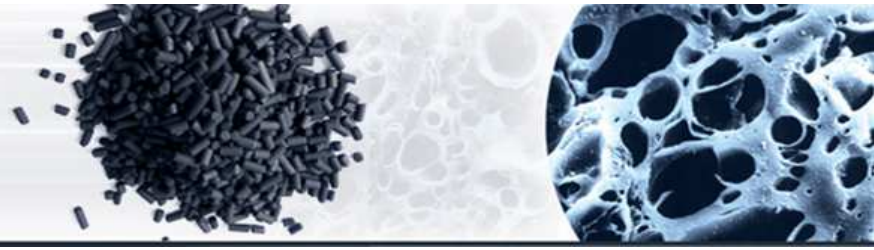
Description of test methods

Iodine number – Water Treatment

- is the quantity (in mg) of iodine adsorbed per gram of pulverized carbon - when the iodine concentration of the residual filtrate is 0,01 mol/l.

  Because of its small molecular size, iodine more accurately defines the small pores or micro pore volume of a carbon and thus reflects its ability to adsorb low molecular weight, small substances.

- Good quality control parameter but higher iodine number does not necessarily reflects a higher performance.



Description of test methods

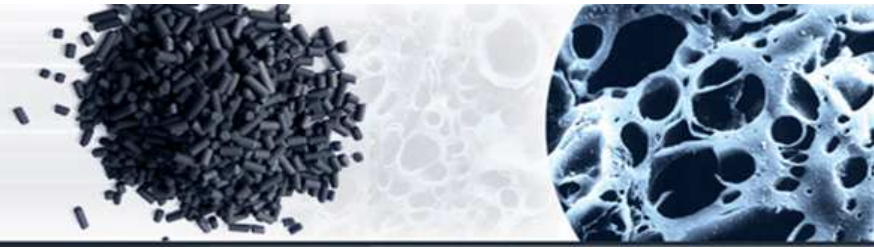
Molasses number – Decolourization

- is used to determine the decolourizing capacity of activated carbon. Comes from the sugar industry where carbon is employed to remove colour. Molasses is a dark, sticky liquid, by-product of sugar production.

- Pulverized activated carbon is added to a solution of molasses at high temperature. Decolourization efficiency is compared to a standard carbon.

  Because colour substances are large, molasses number defines the large pore or macro pore volume of a carbon.

- Manufacturers develop their own methods thus the values are not directly comparable: molasses number, factor…



Description of test methods

Carbon Tetrachloride Activity (CTC) – Gas & Air Treatment

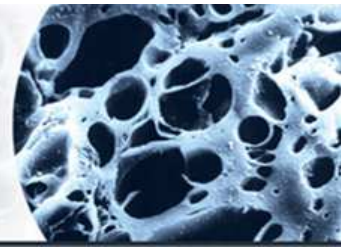
- is the quantity (in g) of CCl_4 adsorbed per 100 grams of activated carbon – under standard conditions, until constant weight is achieved. Unit : wt.%

  The test, however, does not necessarily provide a measure of the effectiveness for others adsorbates.

- Universally accepted as a means of specifying the degree of activation, good quality control parameter.

DONAU CARBON





Comparison of Parameters

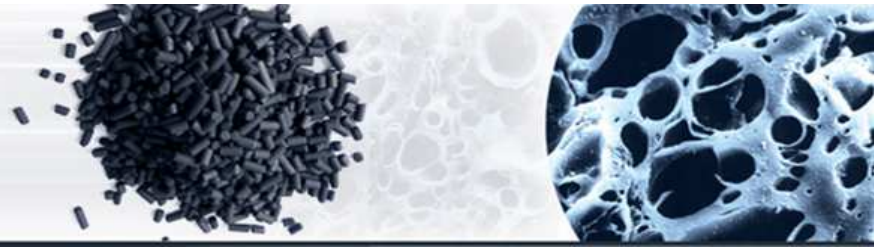
Norit D 10

SPECIFICATIONS

Molasses number (EUR)	**max. 1300**	**-**
Moisture (as packed)	**max. 10**	**mass-%**

GENERAL CHARACTERISTICS

Iodine number	550	-
Molasses number (EUR)	900	-
Methylene blue adsorption	6	g/100 g
Total surface area (B.E.T.)	600	m^2/g
Apparent density (tamped)	600	kg/m^3
Particle size D_{10}	3	µm
Particle size D_{50}	30	µm
Particle size D_{90}	140	µm
Ash content	9	mass-%
Chloride (acid extr.)	0.1	mass-%
pH	alkaline	-
Moisture (as packed)	2	mass-%
Filtration time	20	min

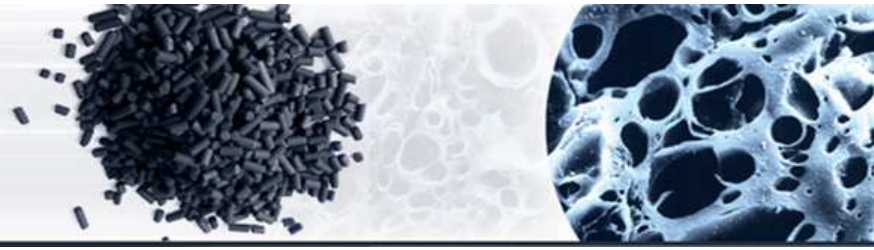


Comparison of Parameters

Norit SA 4 PAH-HF

SPECIFICATIONS

Fluorescent substances	Not detected	-
Light PAH adsorption index	min. 4.3	-
Heavy PAH adsorption index	min. 10.5	-
Moisture (as packed)	max. 5	mass-%
Filtration time	max. 10	min



Comparison of Parameters

Sales efforts – by technical discussion

Comparison DC spec with purchasing spec

Parameter (Unit)	Quality 1	Carbopal PA 4	Carbopal Gn-P
Appearance	powder, without clusters	powder, without clusters	powder, without clusters
Sensory evaluation	neutral, clean	neutral, clean	neutral, clean
Dry solids content (%)	> 90	> 90	> 90
Ash content (%)	< 8.0	< 5.0	< 6.0
pH-value	2 – 4	2 – 4	2 – 4
BET-surface (m^2/g)	1100 – 1300	> 1250	> 1200
Iodine value (mg/g)	900 – 1200	> 1300	> 1000
Molasses Index	70 – 105	70 – 87.5	105 – 175
Calcium (%)	< 1.0	< 1.0	< 1.0
Arsenic (ppm)	< 3.0	< 3.0	< 3.0
Lead (ppm)	< 2.0	< 2.0	< 2.0
Iron (ppm)	< 200	< 200	< 200
Chlorides (%)	< 0.3	< 0.3	< 0.3
Cyanides	unverifiable	unverifiable	unverifiable
Sulphides (ppm)	< 20.0	< 20.0	< 20.0
Zinc (ppm)	< 25	< 25	< 25
Higher aromatic hydrocarbons	unverifiable	unverifiable	unverifiable

R&D, Analyses & Test Series in Our Own Laboratories

Analyses of Adsorbents

- Mechanical, chemical, physical properties
- Adsorption equilibrium
- Water treatment
- Decolourising
- Adsorption kinetics
- Application and process parameters
- Test Series

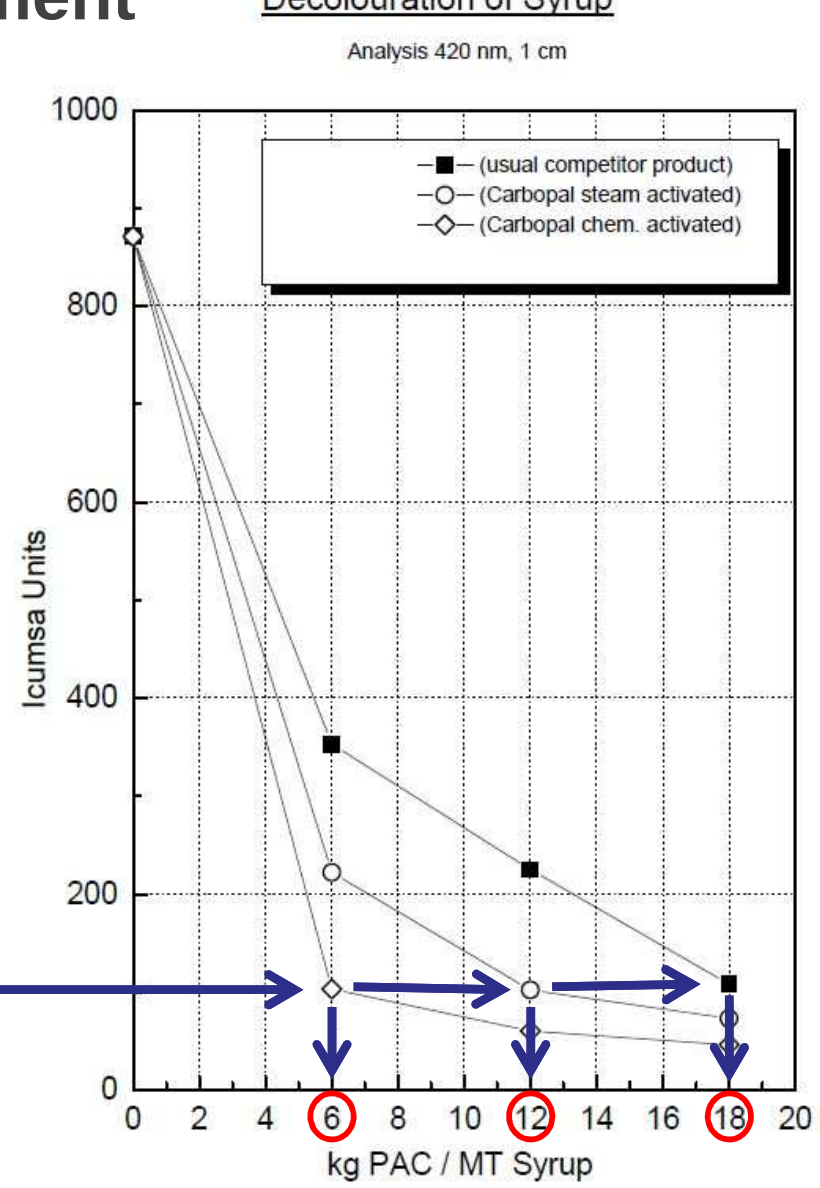
Research & Development



Technical Support Glucose treatment

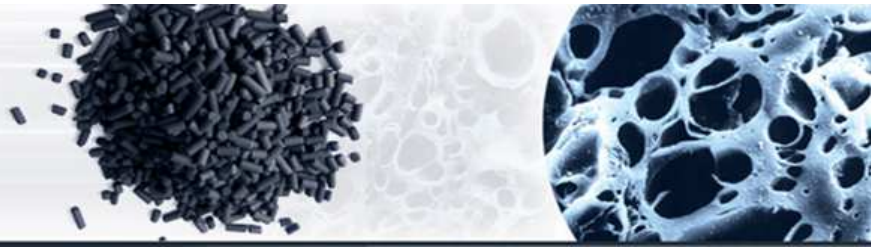
Thanks to laboratory tests, Donau Carbon can determined which product quality is optimized for the client application and which dosage will be needed to achieve the desired bleaching.

Limit: 100 IU



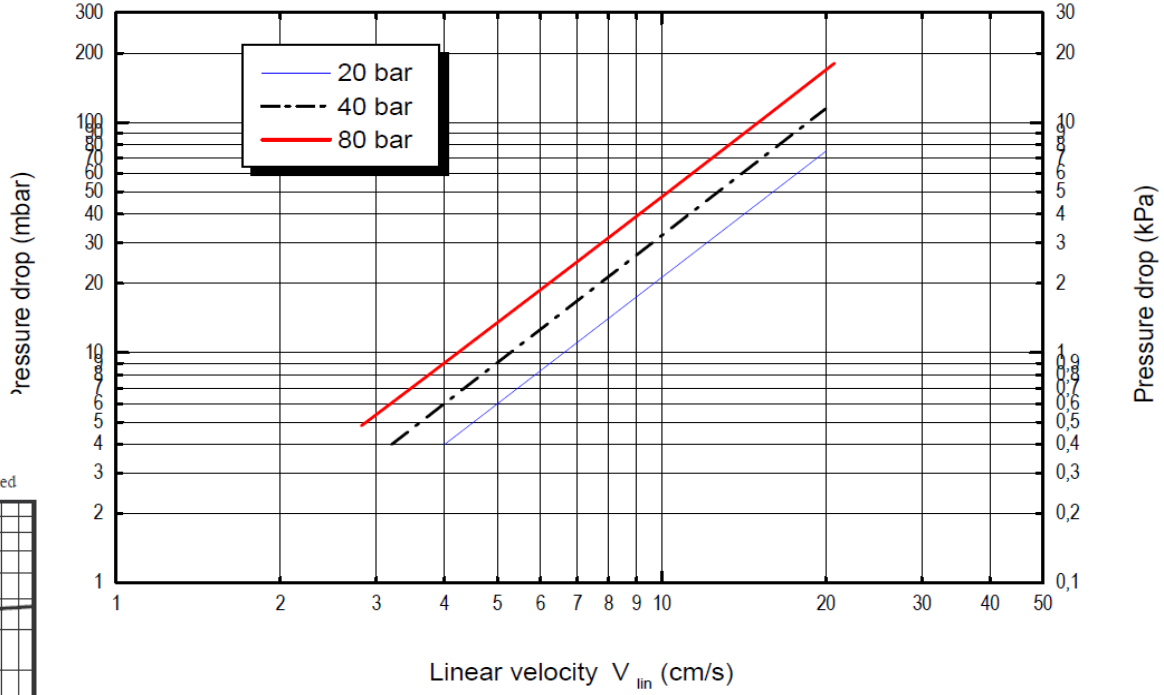
DONAU CARBON

Technical support



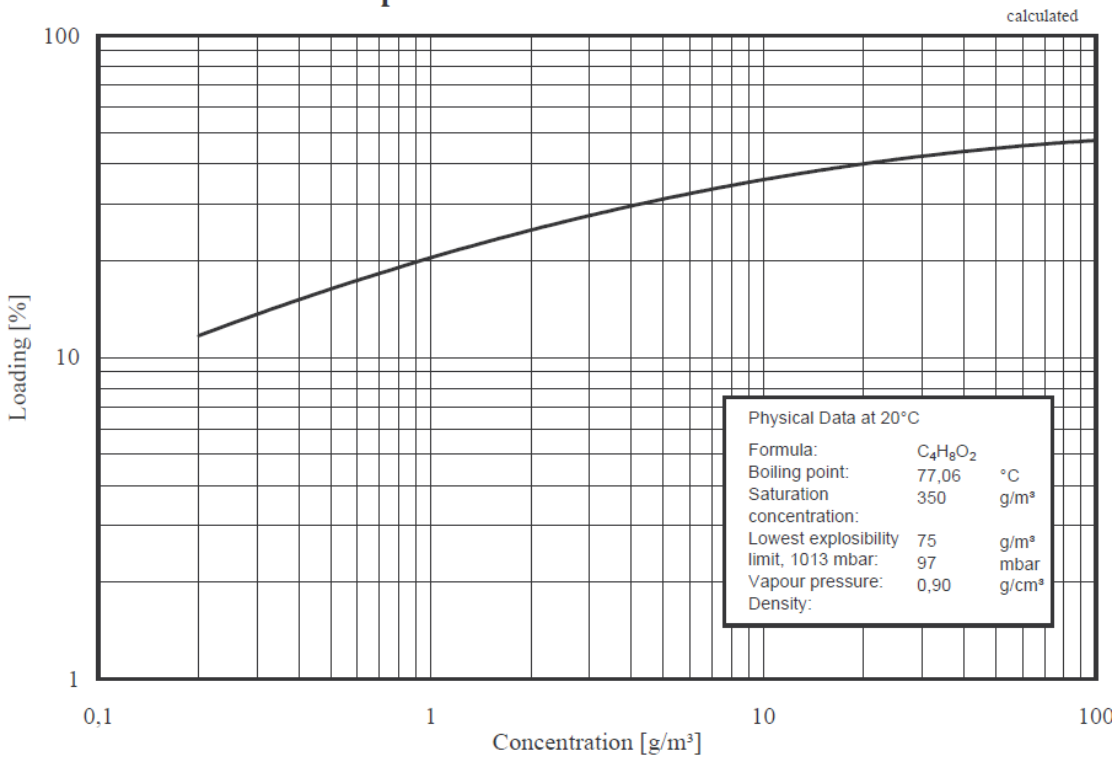
Pressure Drop of 2-mm Cylindrical Activated Carbon

methane (20℃), approx. values for 1 m-layer, dense packing



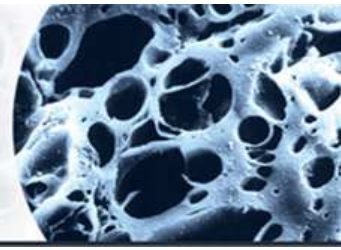
Adsorption Isotherm of **Ethylacetate** from Air at 20° C

Activated Carbon "**Supersorbon K 42**"



DONAU CARBON





Technical support

Gas calculation / life time

Based on gas conditions /

Filter dimension

Plant design for H2S removal with Desorex PI50K

Customer: Union Engineering - Niels Zöga Rytter Larsen

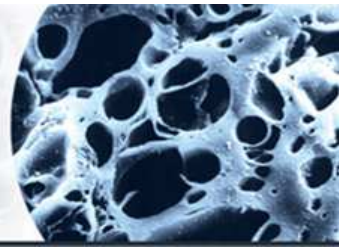
Project: CO2 cleaning - H2S removal_rev1

Project Argentina

Parameter	Value (data given)	Value (calculated)	Unit	Conditions / Basis		
GAS PARAMETERS						
Inlet gas stream		4.514	kg/h	Stream $_{dry}$	Density	1,980 kg/m³
Inlet gas stream		2.279,6	Nm³/h	Stream $_{dry}$		
		2,0	mmscf/d	Stream $_{dry}$		
Inlet gas stream		2.285,5	Nm³/h	Stream $_{wet}$		
		2,0	mmscf/d	Stream $_{wet}$		
Inlet gas stream		123,6	m³/h	**effective (T- and P- adjucted)**		
		0,11	mmscf/d	**effective (T- and P- adjucted)**		
Inlet gas temperature	38,8		°C	in front of the vessel		
Dew point	15,0		°C	relating to S_{wet}		
Inlet gas humidity		0	Vol.-% H_2O	relating to S_{wet}		
Inlet gas pressure	21,4		bar a	absolute		
Inlet gas density	1,98	1,98	kg/Nm³	normal conditions		
		36,62	kg/m³	effective conditions		
IMPURITY IN GAS						
H2S - concentration	9,2	9,160	vppm	relating to S_{wet}		
		13,928	mg/m³	relating to S_{wet}	with molar mass =	34,08 g/mol
H2S amount in gas		0,032	kg H2S / hour			
O_2 - Amount (if needed)	2			-fold stoichiometric value relating to the impurity concentration		
O2 - flow		0,021	m3/h	relating to S dry		
Consequential air amount		0,100	m3/h	relating to S dry		
FILTER DIMENSIONS						
Vessel diameter	1.300	1.300	mm			
Activated Carbon Bed height	1,5	1,5	m	cross sectional area:		1,33 m²
Consequential carbon volume		1,99	m³			
weight		995	kg	based on Desorex PI50K density		500 kg/m³
Effective linear gas velocity		2,6	cm/s	usually max 40 cm/s		
Residence time in the vessel		58,0	seconds			
Expected average H2S loading	15		% (weight)	onto Desorex PI50K		
Consequential lifetime		4.703	h			
		196	days			
		28	weeks			
		6,5	months			

DONAU CARBON





Technical support

Water calculation / life time

Calculation for OIL removal from WATER with Hydraffin 30N

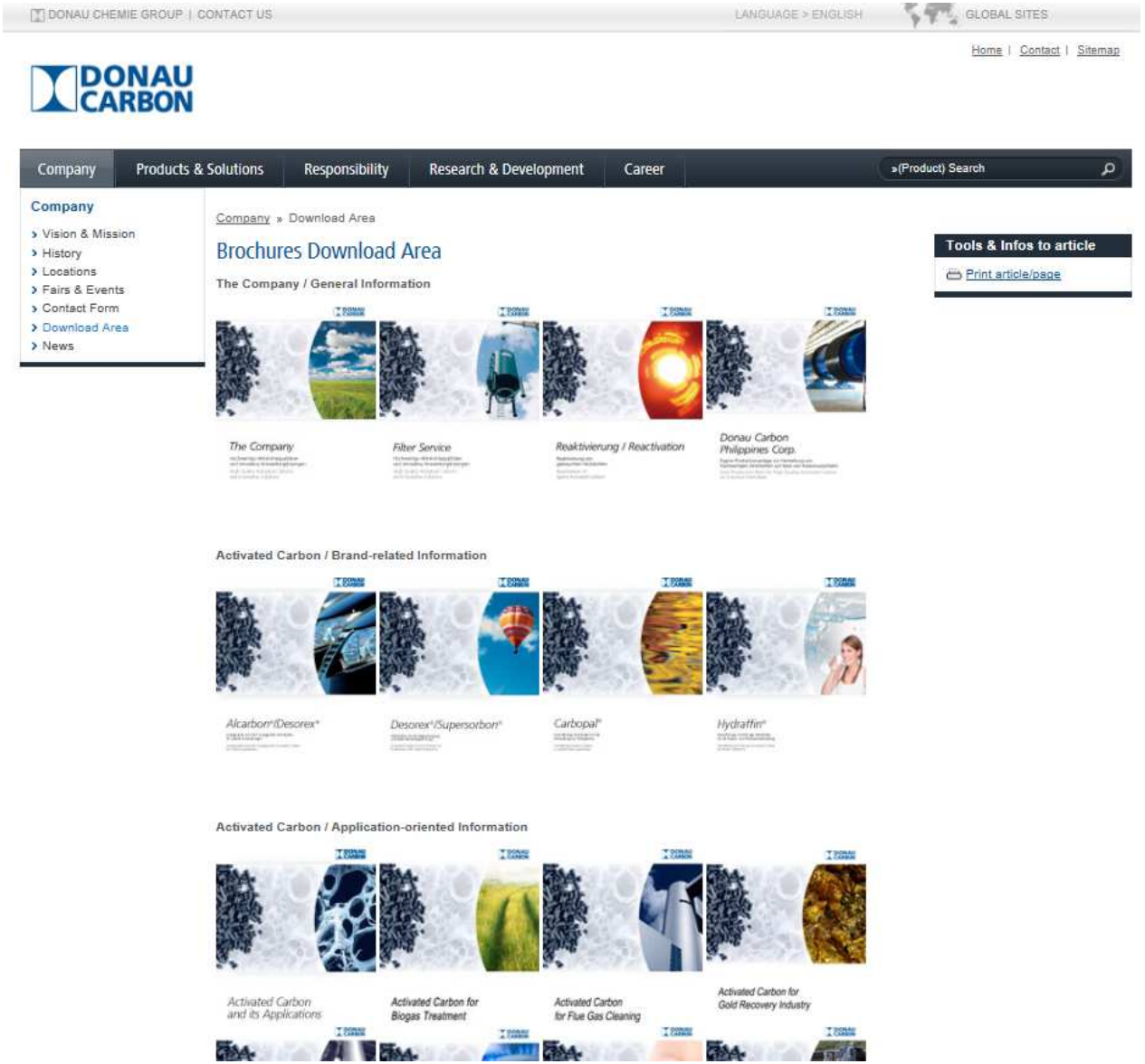
Customer: EIGENMANN & VERONELLI SPA

Project: Oil removal

Parameter	Value (data given)	Value (calculated)	Unit	Conditions / Basis	
PARAMETERS					
Flow rate	80,0		m^3/h	WATER flow	
IMPURITY					
OIL - concentration	20,0		g/m^3 (= mg/l)		
OIL amount in WATER		1.600,00	g OIL / hour		
		38.400,00	g OIL / day		
Assumed OIL outlet conc.	5,0		g/m^3 (= mg/l)		
FILTER DIMENSIONS					
Vessel diameter	2,5 m	2.500	mm		
Activated Carbon Bed height	4 m	4.000	mm	cross sectional area:	4,91 m^2
Consequential carbon volume		19,63	m^3		
weight		8.639	kg	based on Hydraffin 30N backw. der	440 kg/m^3
Effective linear velocity		16,3	m/h	typically max. 18 m/h	
Contact time in vessel		15	min	typically 5 - 15 min	
Estimated average OIL loading		400	g/kg (= mg/g)	onto Hydraffin 30N	
Consequential lifetime		90	days		
		3,0	months		

Technical brochures

Available on our website



Thank you for your attention



Sep-15
©Donau Chemie Group / All rights reserved!