

Activated Carbon Purification





Introduction

- We are a global manufacturer, supplier and service provider of
 - Activated carbon products
 - Filter aids products
 - Spent carbon recycling services
 - Mobile activated carbon filters
 - On-site technical support
 - Developer of novel products and applications





Corporate Profile

- World's largest producer of Granular Activated Carbon
- Solves customer purification and separation problems with an array of technologies
- Diverse product portfolio from drinking water over food to industrial waste applications
- Acquired by **CUCOLOY** in March 2018



\$617.1 million net sales In 2019

Over 75 years experience

1,400+ employees

25 offices Sales and service

20 facilities Manufacturing, reactivation, equipment

205 patents



Global Presence



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How Our Products Help Customers and Society



Provide clean, safe drinking water



Reduce environmental impact and allow wastewater reuse or disposal



Remove and recover contaminants from air emissions



Protect global marine ecosystems from invasive species



Purify food products



Enhance critical stages in chemical manufacturing

More than 600 applications



Protect your personal environment



Accelerate wound healing

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The Reactivation Cycle





Activated carbon – What does it do?



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Activated Carbon Definition

- ✓ Crude form of graphite
- ✓ Random or amorphous structure
- ✓ Highly porous
- $\checkmark\,$ Wide range of pore sizes





Very High Surface Area





How Does Activated Carbon Work?



Intermolecular attractions in the smallest pores (adsorption pores) of the carbon particle result in adsorption forces that:

- Cause precipitation of adsorbates from solutions
- Cause condensation of adsorbates from gases

Molecules are then held in place on the interior surfaces of activated carbon



Molecular Structure - Loaded Activated Carbon 10,000,000 X Magnification



Adsorbate in a liquidlike state

loo Å



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Carbon skeleton

Adsorption pores

Transport pores



Forms of Activated Carbon



Different forms available along the requirements of the applications





What does it remove?





Different Adsorption Strengths

- All compounds are adsorbable to some extent
 - Organic and larger molecular weight inorganics





Impregnated Activated Carbon May be Used to

- Remove some materials that are not adequately removed by physical adsorption, or when physical adsorption on "regular" carbons will not work
 - Low MW organics
 - Ex CH₂O
 - Inorganic molecules
 - Ex. H₂S, COS, NH₃, Hg, PH₃, ASH₃

Impregnated carbon ~ porous reactor filled with active agent

- Chemical reaction \rightarrow reaction product retained
 - Temperature, humidity, pressure, concentration important factors
- Reduction for organic adsorption
 - Combined beds can be solution







Plug and Purify

- · Combined transport vessel and adsorber
 - No on-site carbon handling
- Simple installation and operation
 - Installation in series or parallel is possible
 - Flexible in use
 - Efficient pilot installation
- Simple remote operation
- Ready for use
 - Rapid delivery
- Cost effective
 - No investment cost





Purification of Syngas



Syngas

Typical contaminants removed

- Biomass
 - Hydrocarbon ex. Terpenes
 ENVIROCARB[®]
 - H₂S COS
 SOLCARB[®]
- Refinery
 - Hydrocarbon

ENVIROCARB[®]

- H₂S COS SOLCARB®
- Hg

HGR®



Process parameters

- Flow
- Pressure
- Temperature
- Humidity
- Oxygen
- Concentration
 - Impurities
 - Other compounds

Example – Removal of terpenes biosyngas

| Flow rate | Nm³/h | 1000 |
|-------------------|-------|----------------------|
| Pressure | mbarg | 150 |
| Temperature | °C | Ambient |
| Adsorber | | MACH4 |
| Activvated carbon | | ENVIROCARB 207EA 4x8 |
| | kg | 9000 |

| Contaminants | | |
|---------------------|------|------|
| C5 | ppmv | 26.1 |
| C6 | ppmv | 2.4 |
| C7 | ppmv | 1.2 |
| C8 | ppmv | 1.4 |
| Benzene | ppmv | 0.5 |
| Toluene | ppmv | 2.7 |
| Methyl ethyl ketone | ppmv | 11.5 |
| Pinene | ppmv | 3.1 |
| Carene | ppmv | <0.1 |
| Cymene | ppmv | <0.1 |
| Limonene | ppmv | 12.7 |
| Other | ppmv | 44 |





Conclusion



- Activated carbon is a versatile means for purification
- Plug and Purify through mobile adsorbers
- Recycling through thermal (off-site)
 reactivation



Thank you for your attention!

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