

Value Added Products from Gasification

Activated Carbon

ABETS

What is Activated Carbon?

- Activated carbon has the strongest physical adsorption forces or the highest volume of adsorbing porosity of any material known to man.
- Very high surface area 500 – 1500 m²/g
- Highly porous structure – Consists of micro-pores, meso-pores and macro-pores.

Uses of Activated Carbon

- For removal of taste, odor, color in water treatment applications
 - Food processing and chemical industries
 - As catalyst and catalyst support for many inorganics
 - In air pollution control
-uses are really large

Properties

- Surface area
 - ◆ Determines the adsorption capacity. Usually found by the adsorption of nitrogen (BET method)
 - ◆ Depends on the micro-pores
- Physical properties – density, hardness, particle size

Other Indicators to Adsorbing Properties

- Iodine number — Adsorption of iodine from solution.
 - ◆ Represented as milligram of iodine adsorbed per gram of carbon
 - ◆ The iodine number is nearly equal to the surface area in m^2/g
- Decolorizing Power
 - ◆ Adsorption of dyes from solution — Methylene blue number

Other Indicators to Adsorbing Properties (contd.)

- Adsorption capacity — adsorption of organic vapors from air stream
 - ◆ Carbon tetra chloride
 - ◆ Benzene
- Oil retention and filterability
- Hardness number — Percentage retained in a sieve of given mesh size after shaking the material along with steel balls for a specific time.

Source

- Biomass – Wood, coconut shell, etc
- Charcoal made thermally driving away volatiles
- Charcoal activated by steam or by acid wash

As a byproduct from Gasification

- With coconut or wood chips as feed stock, activated charcoal can be extracted from the reactor at varying rates.
- The yield of charcoal range from 4 % to 20%
- Iodine number obtained range from 200 – 800. Larger iodine number obtained with lower yield.
- Charcoal can be further activated with steam or nitrogen

Advantages of obtaining Activated carbon from gasifier

- Utilization of energy of volatiles
- High quality charcoal
- Environment friendly. Does not produce pollutants as in the conventional process.
- Improves the economics of gasifier operation.
- Control over the quality of char generated.

Steam Activation of Charcoal

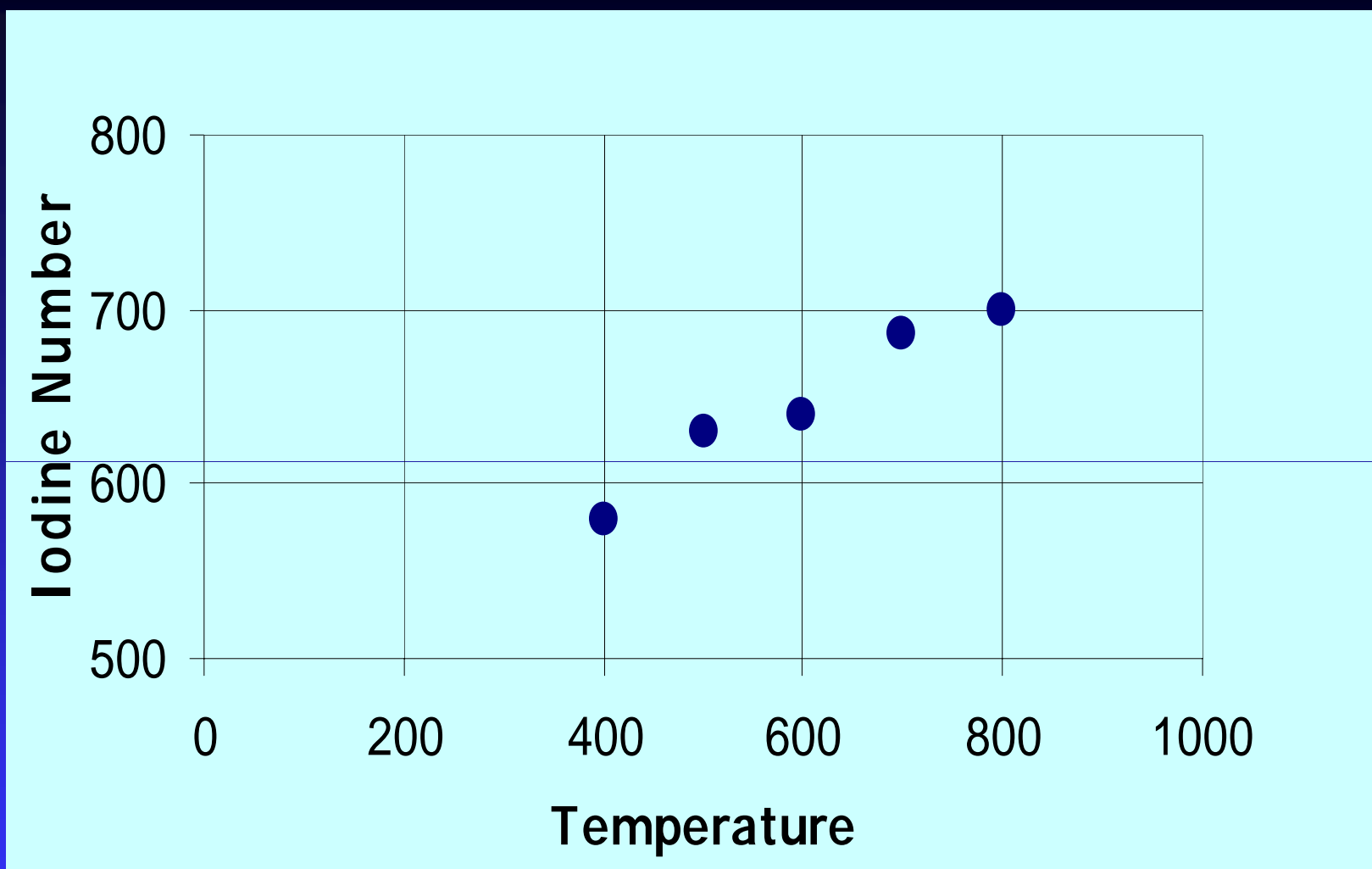
- Pass steam through a bed of charcoal at 600-800°C for 8 – 12 minutes
- Micro pores are opened by reaction of steam with carbon
- Iodine number increases with time initially, but decreases subsequently due to coalition of micro pores
- Carbon is consumed because of reaction of H_2O with carbon
- Iodine number in excess of 1000 can be obtained

Steam Activation ... contd

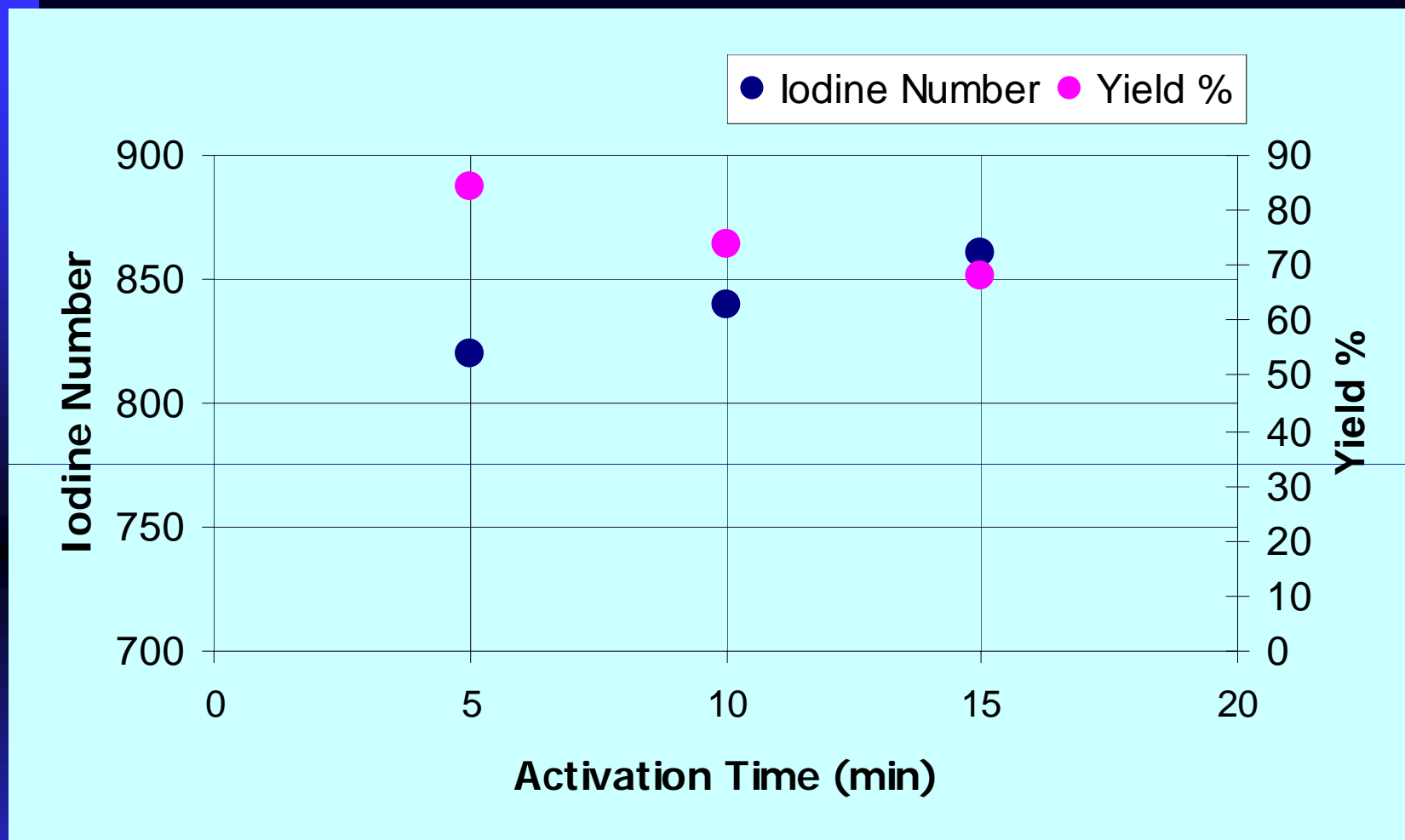


Activation using Inert Gases

- Activation can be achieved by exposing carbon to inert gases at high temperature.
- Loss of carbon during the activation is negligible
- No tendency for reduction in iodine number with time of exposure
- Further work in progress for activation with combustion products.



**Fig 1 : Temperature vs Iodine Number
(Coconut char sample)
Reaction Time: 15 minutes**



**Fig : 2 Time vs Iodine Number & Yield %
(Eucalyptus Char sample)
Reaction Temperature : 850 C**

Summary

- Large demand for activated carbon as it is used in almost all industries for as an adsorbent
- Is characterized by high surface area for adsorption
- Gasification route – efficient way of producing activated carbon
- The char obtained after gasification is partially activated with surface area of around $500 \text{ m}^2/\text{g}$
- Further increase in surface area achieved by simple steam activation – yields activated carbon surface area $> 800 \text{ m}^2/\text{g}$

.....*Thank you*.....