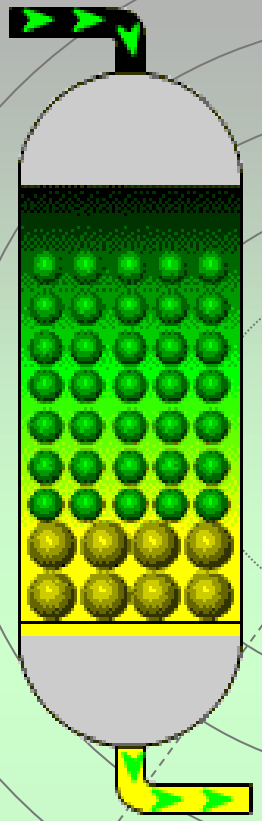
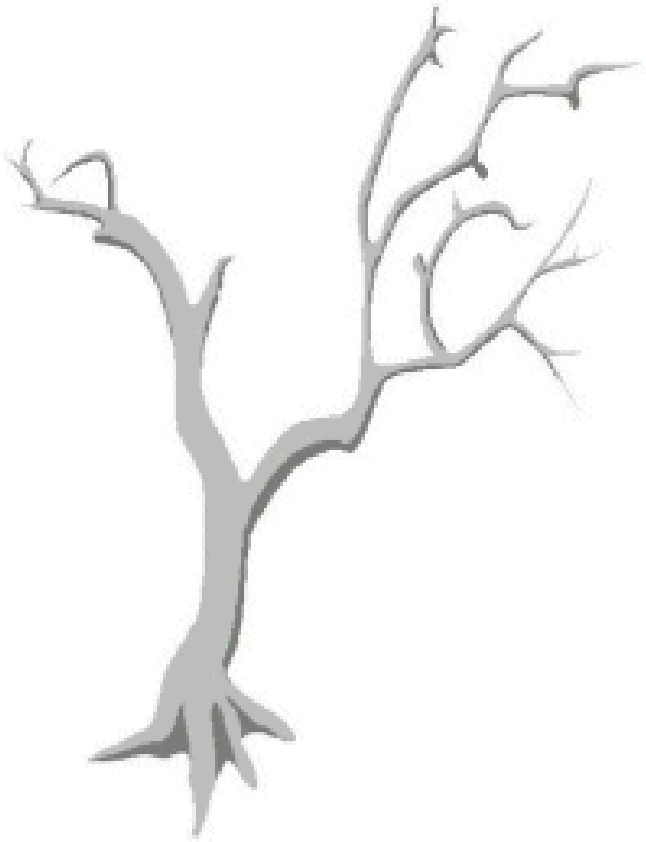


ADSORPTION

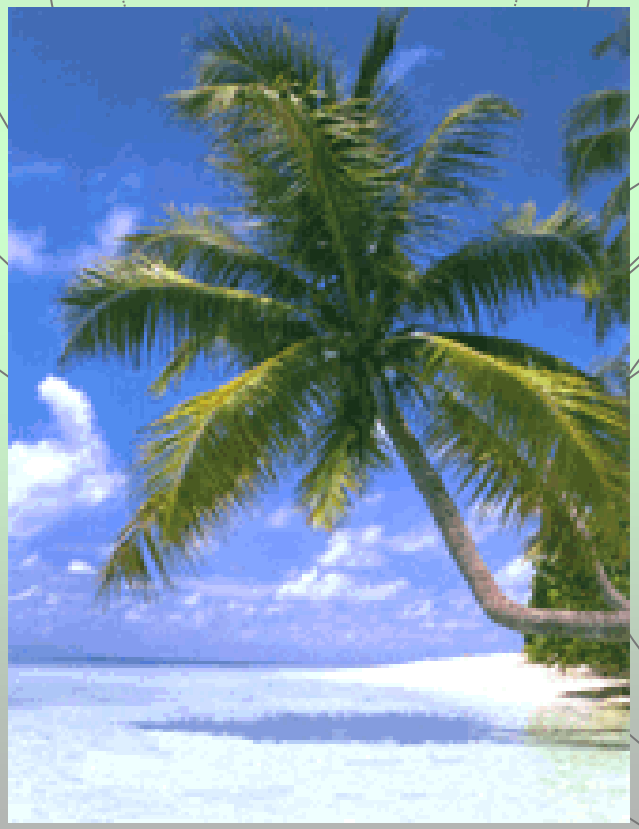
The removal of dissolved substances from solution using adsorbents such as activated carbon

Adsorption versus Absorption

The physical form of the GAC may depend on source of raw materials

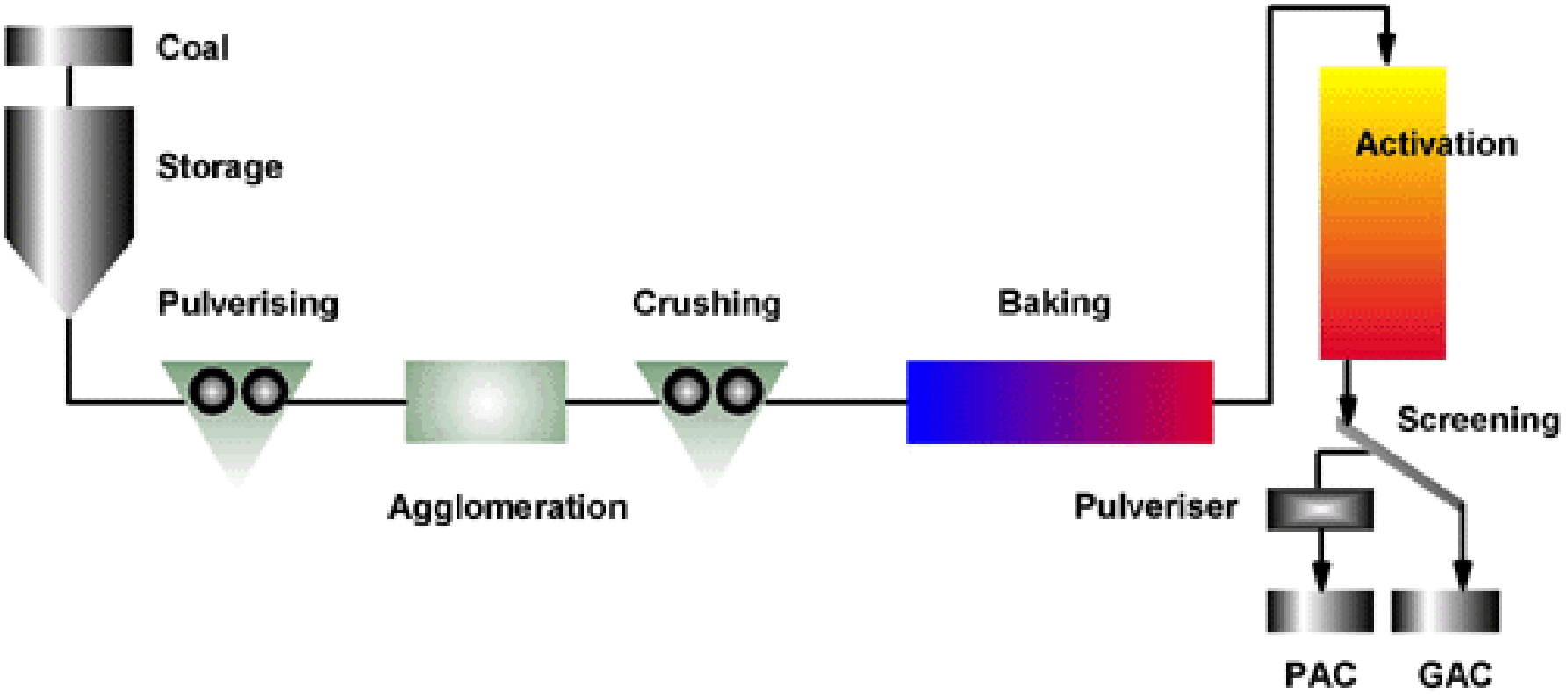


MANUFACTURE OF ACTIVATED CARBON: DIFFERENT RAW MATERIALS



Prior carbonization for softer raw materials

MANUFACTURE OF ACTIVATED CARBON FROM COAL

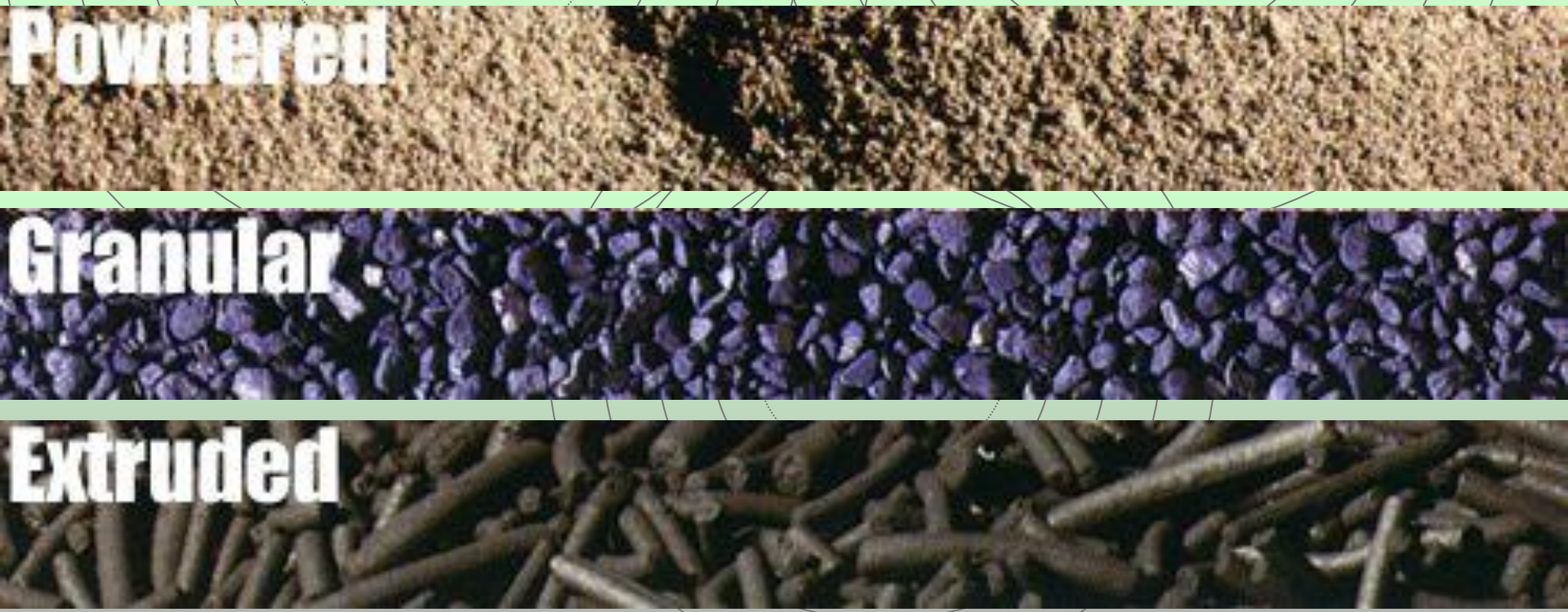


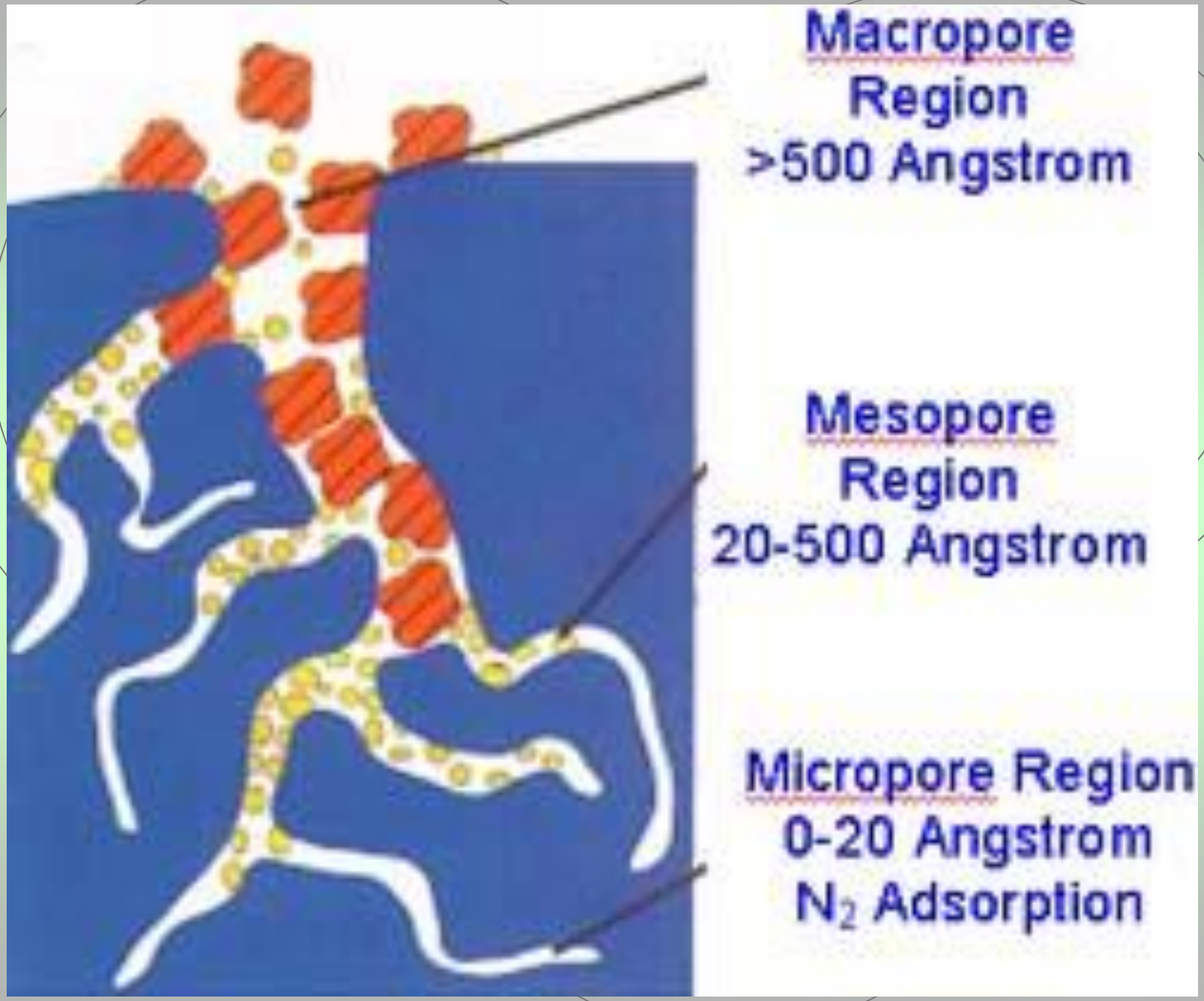
Multiple Hearth ↑

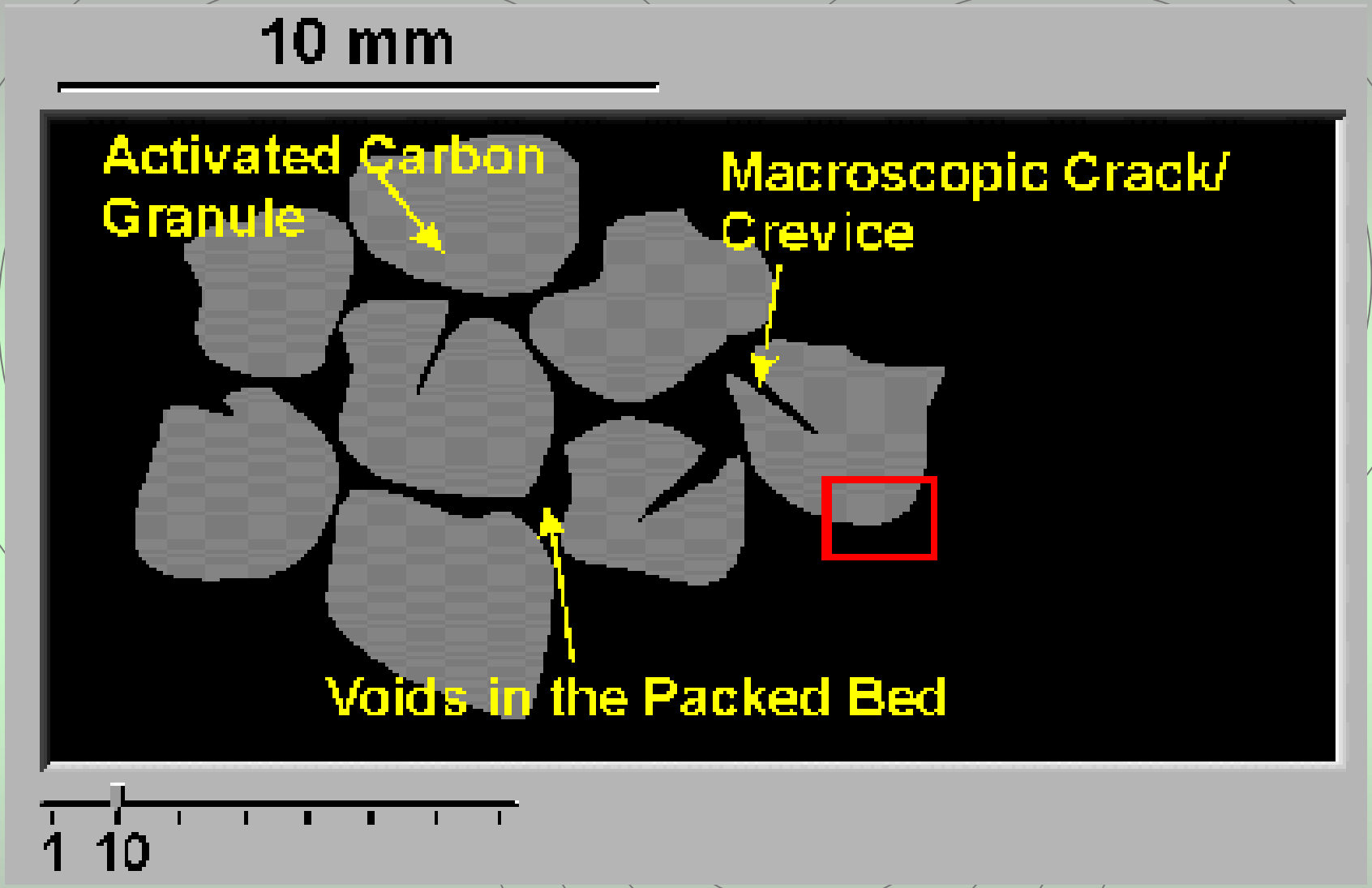
ACTIVATION FURNACE TYPES

Rotary kiln →

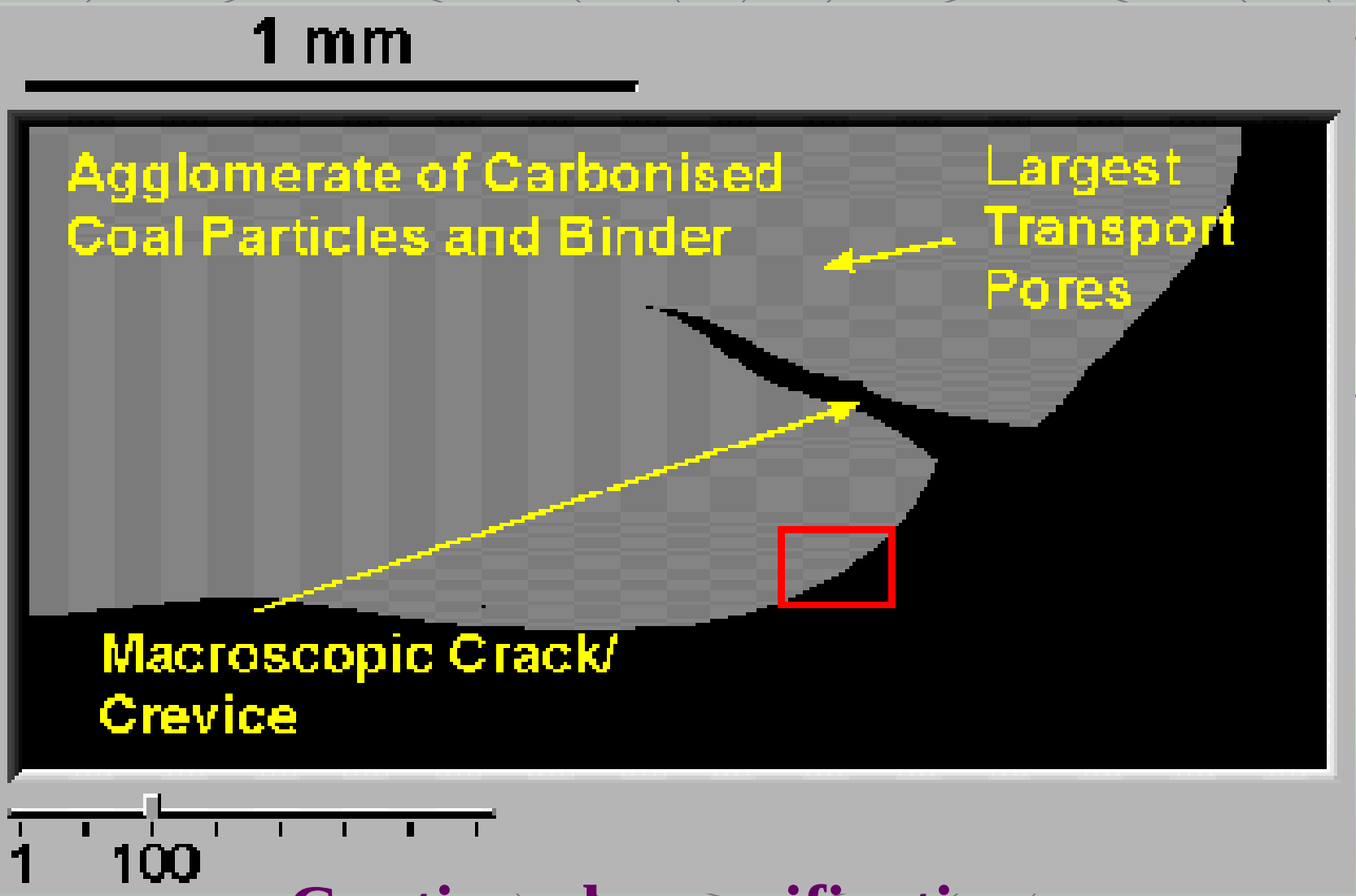
DIFFERENT PHYSICAL FORMS OF ACTIVATED CARBON



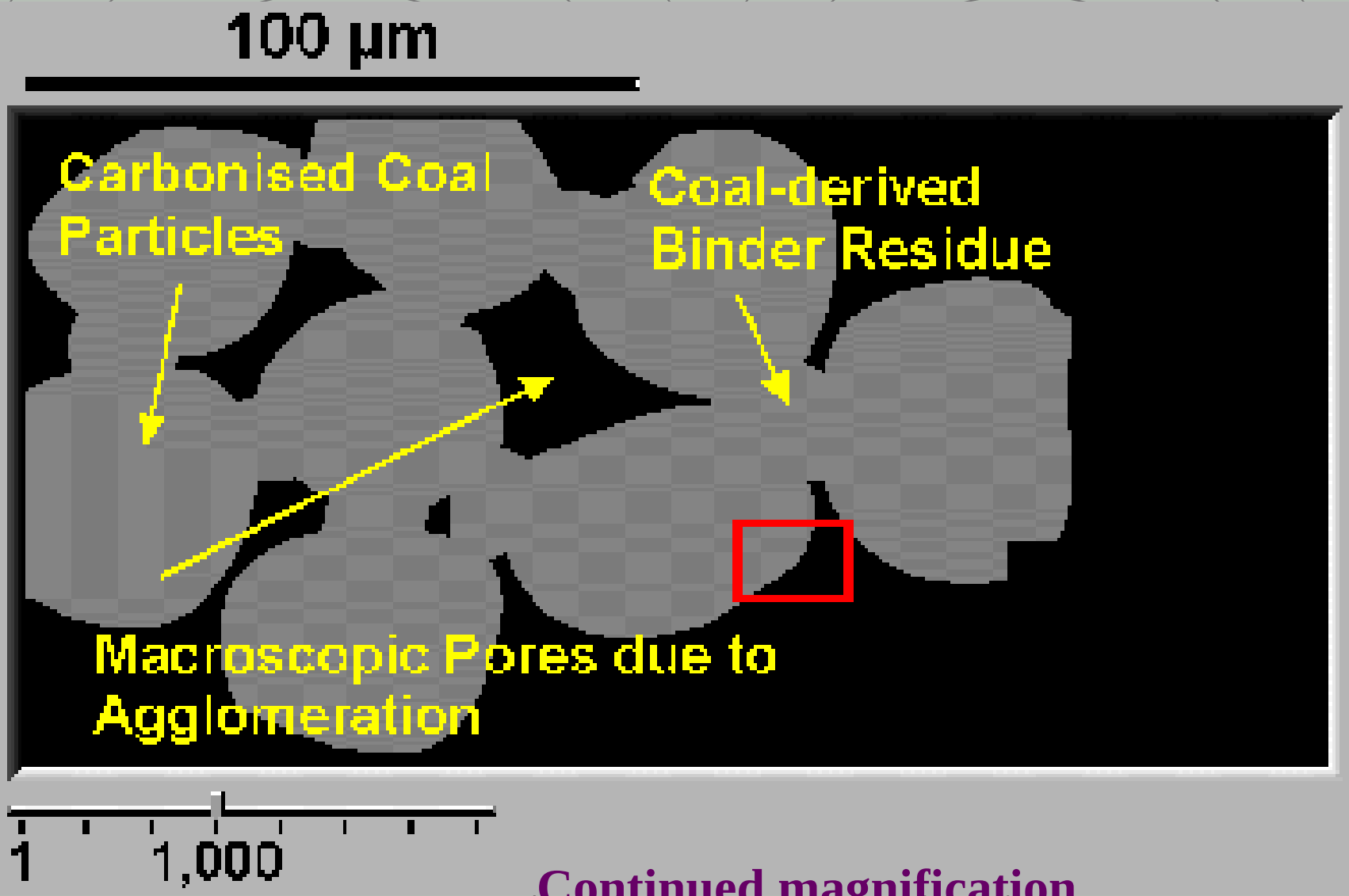

Macropore
Region
>500 Angstrom
Mesopore
Region
20-500 Angstrom
Micropore Region
0-20 Angstrom
N_2 Adsorption



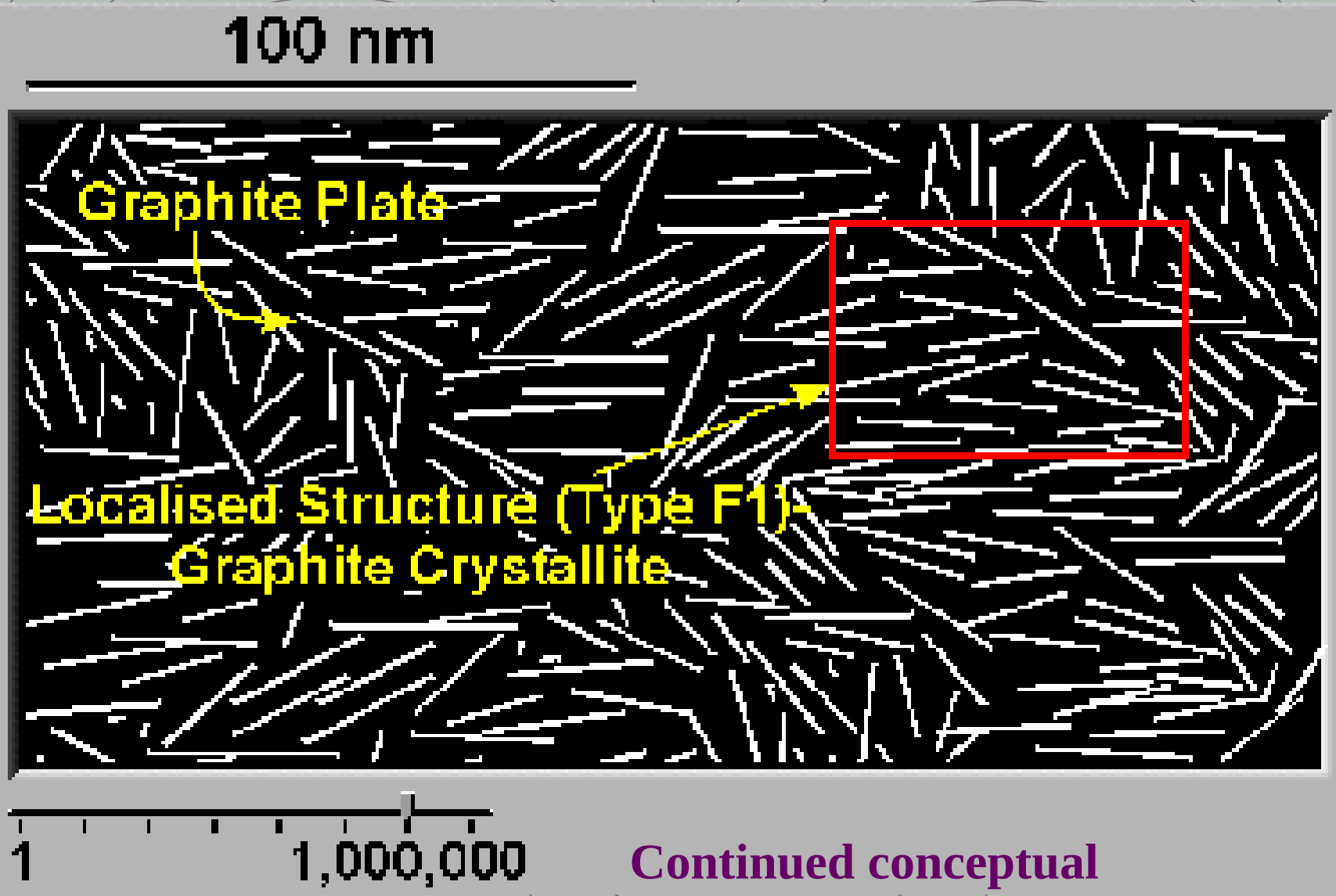
First magnification of carbon granules



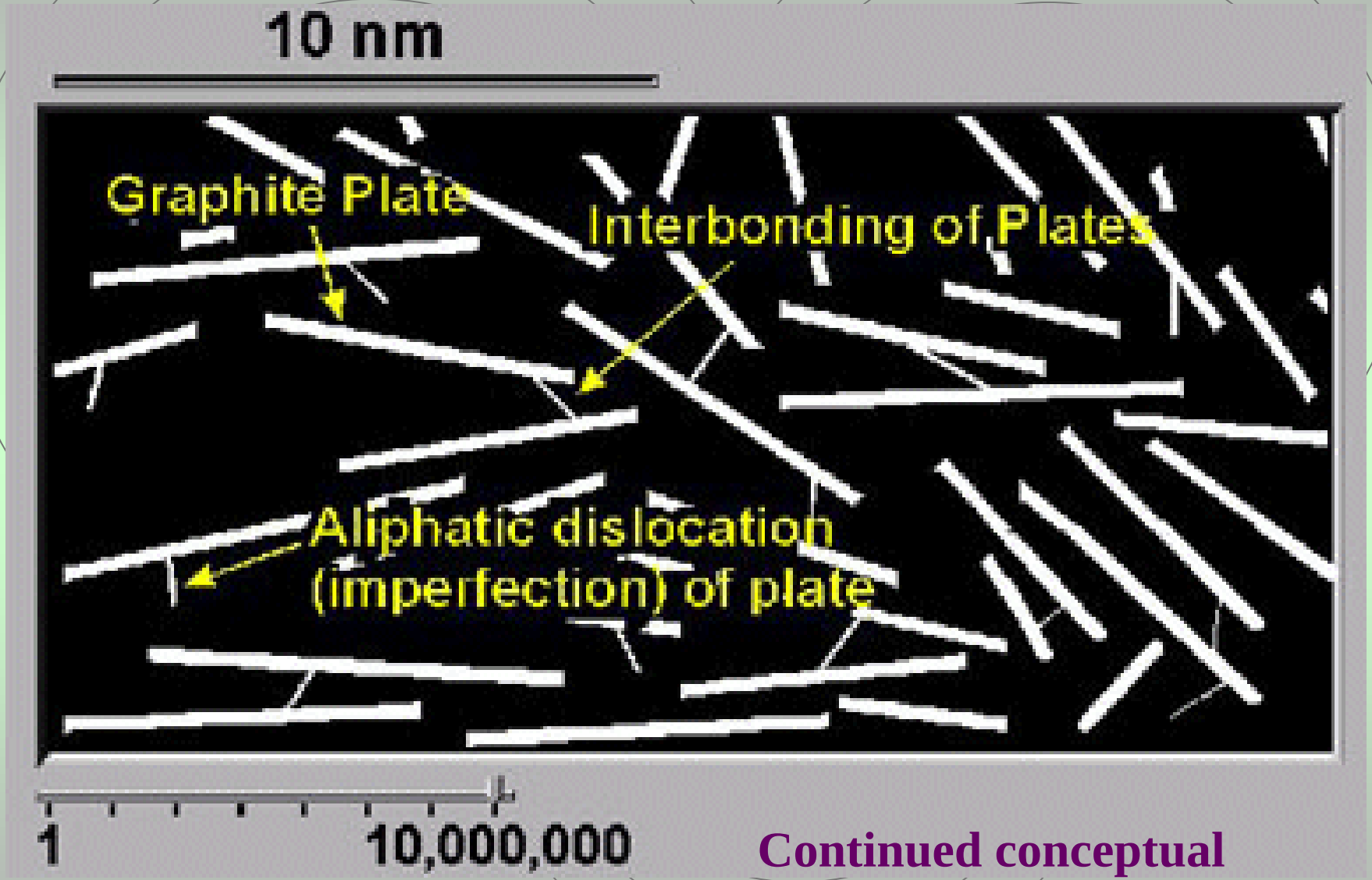
Continued magnification



Continued magnification

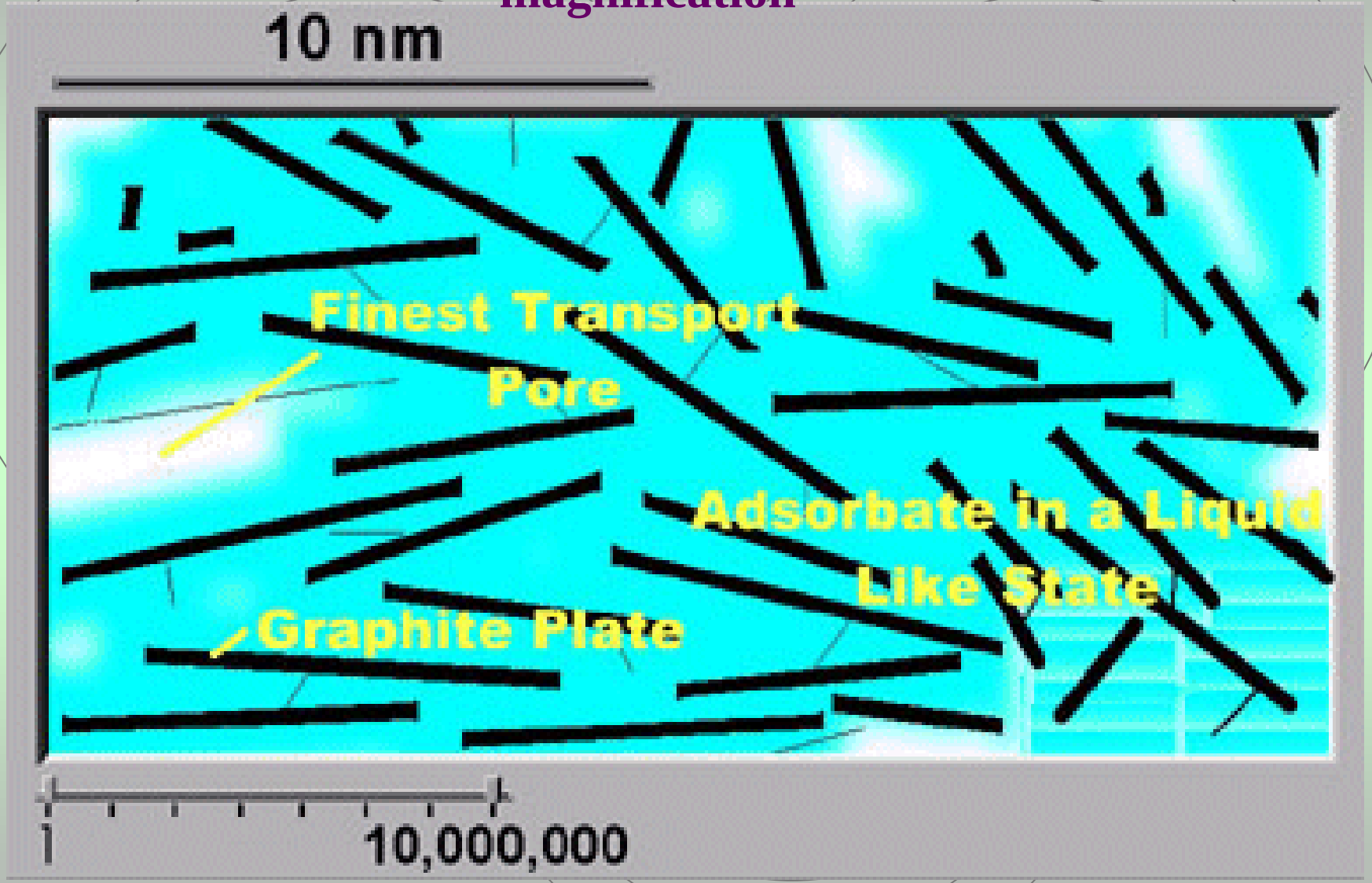


Continued conceptual magnification

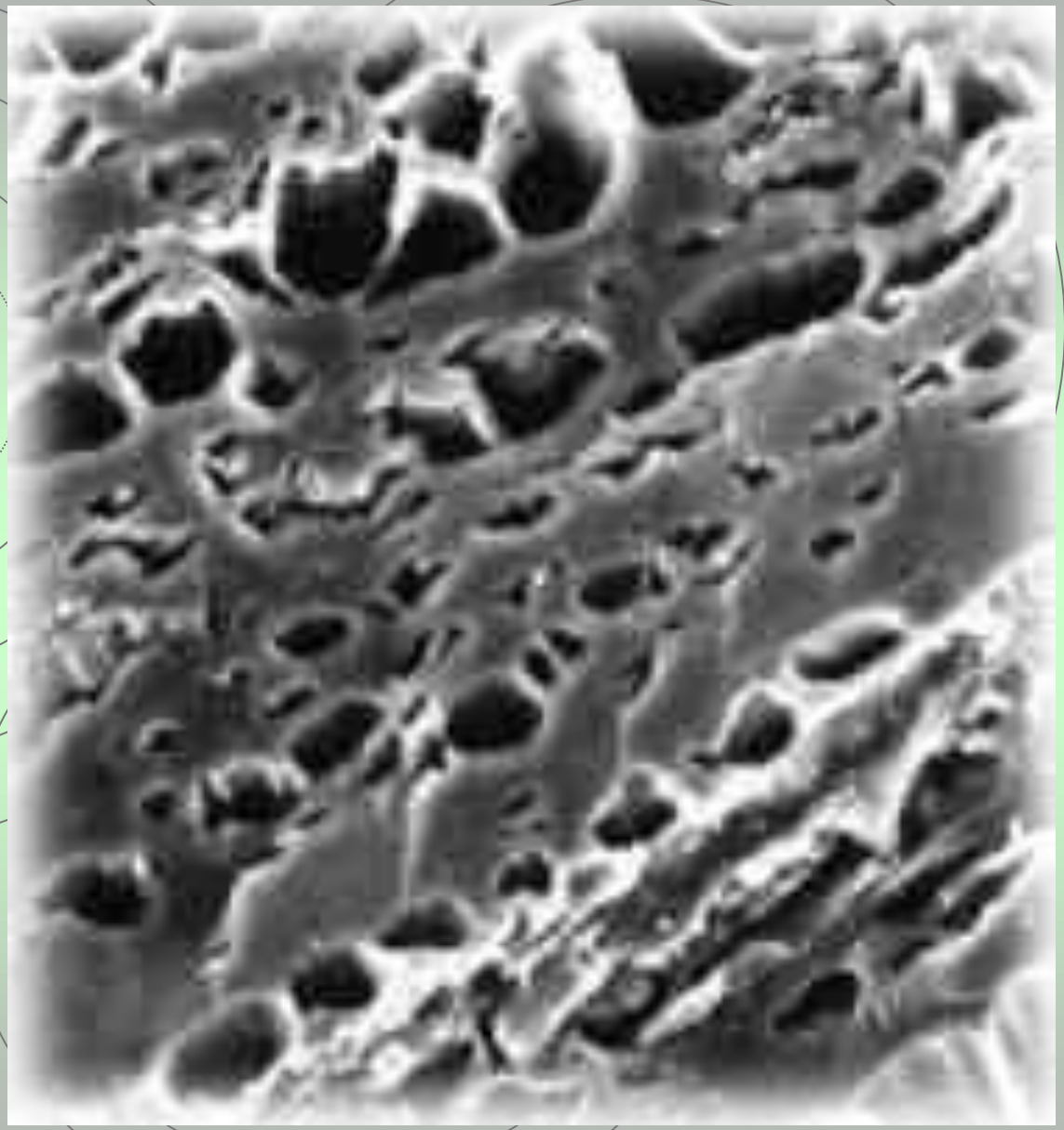


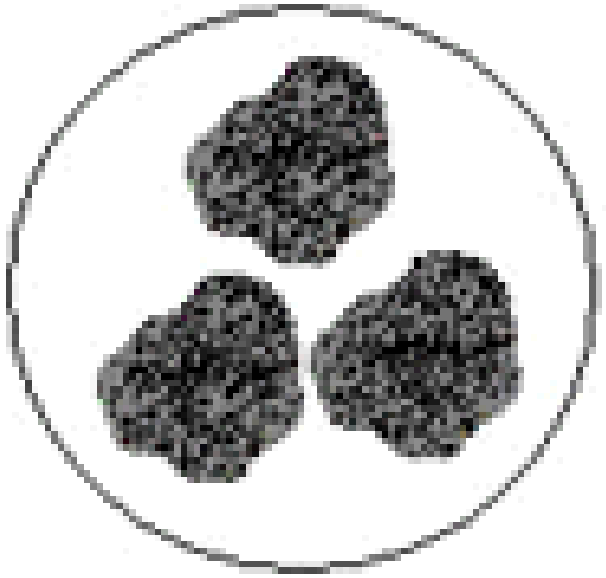
Continued conceptual magnification

Continued conceptual magnification

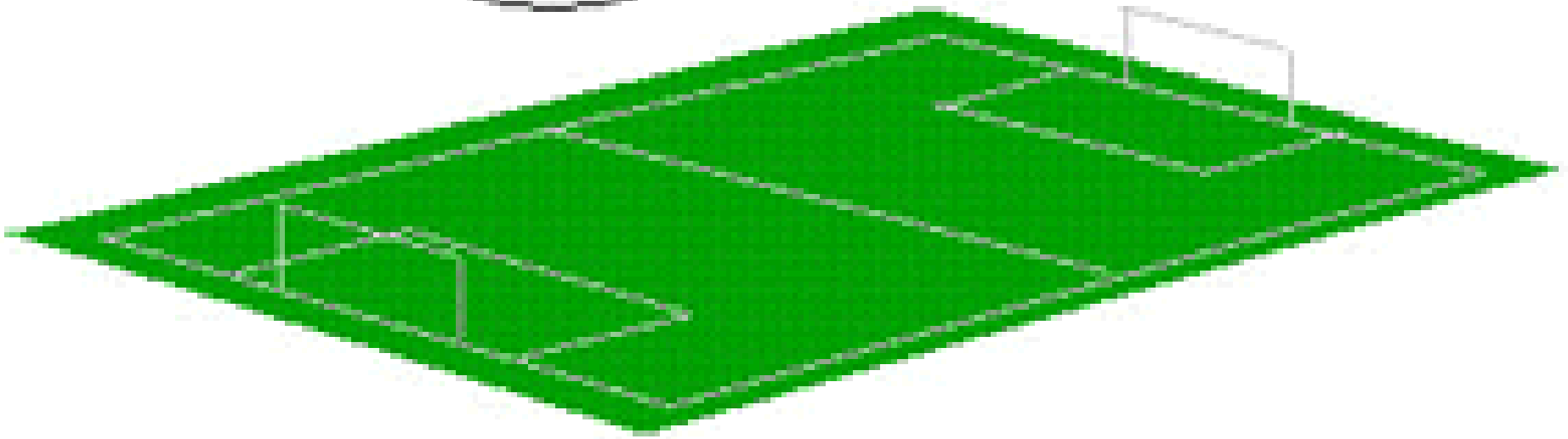


Scanning Electron Microscope Photo of GAC

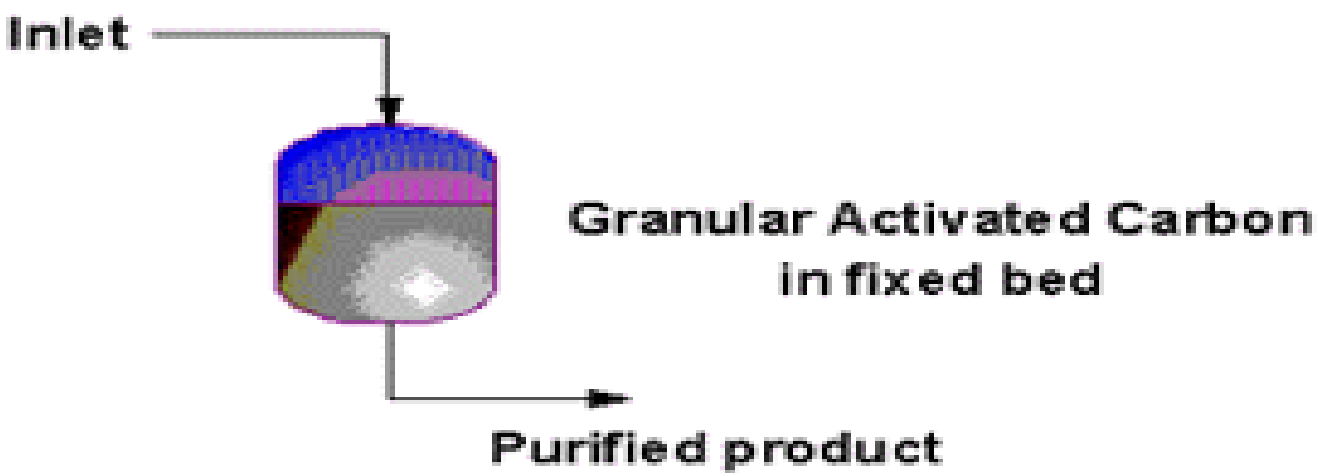




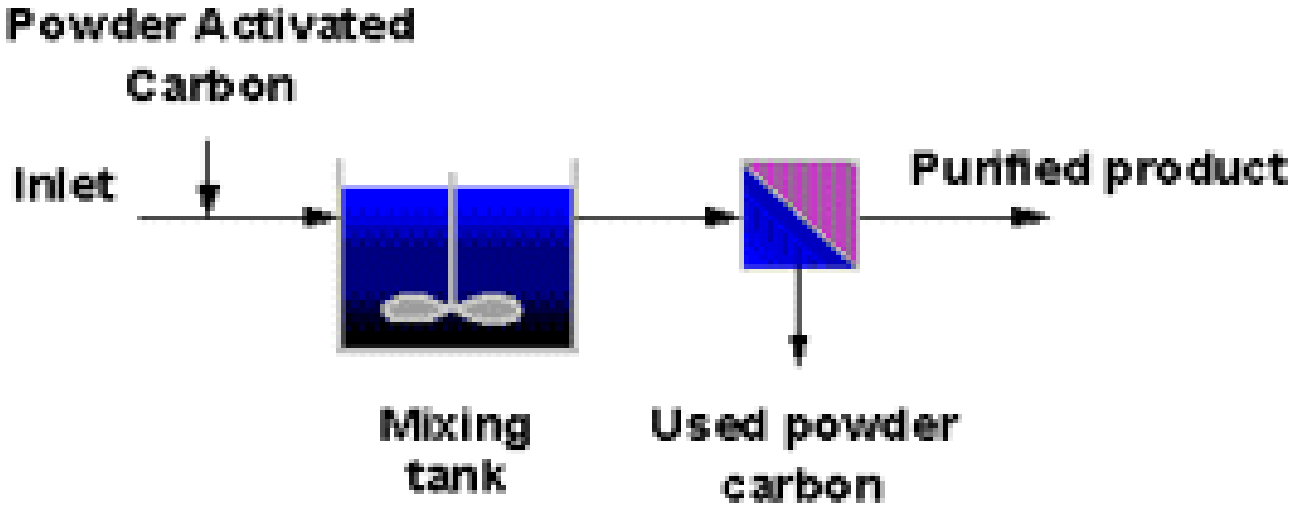
Area of a few grams of activated carbon



Application Methodology



Principle of a granular activated carbon adsorption system

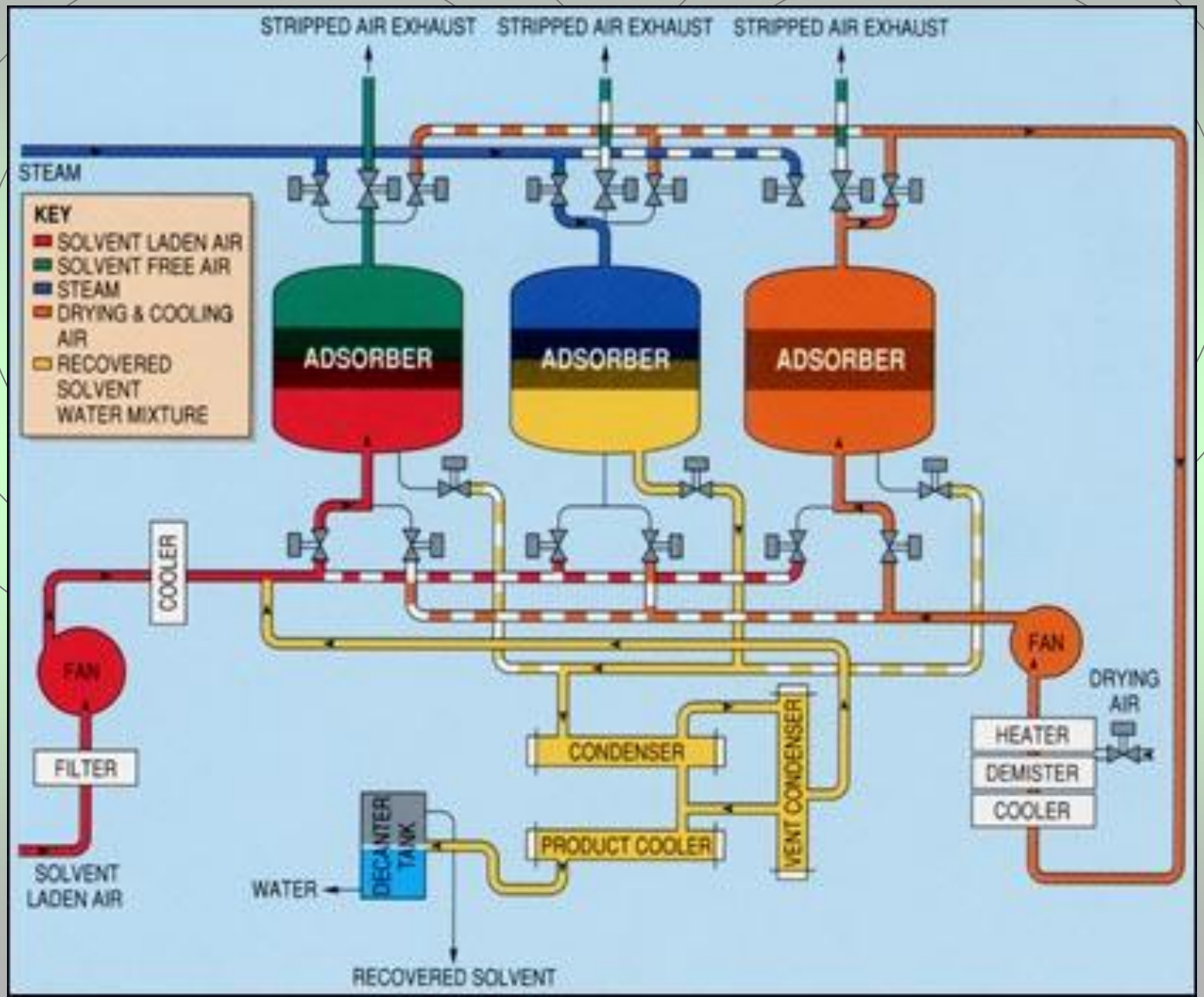


Principle of a powder activated carbon adsorption system

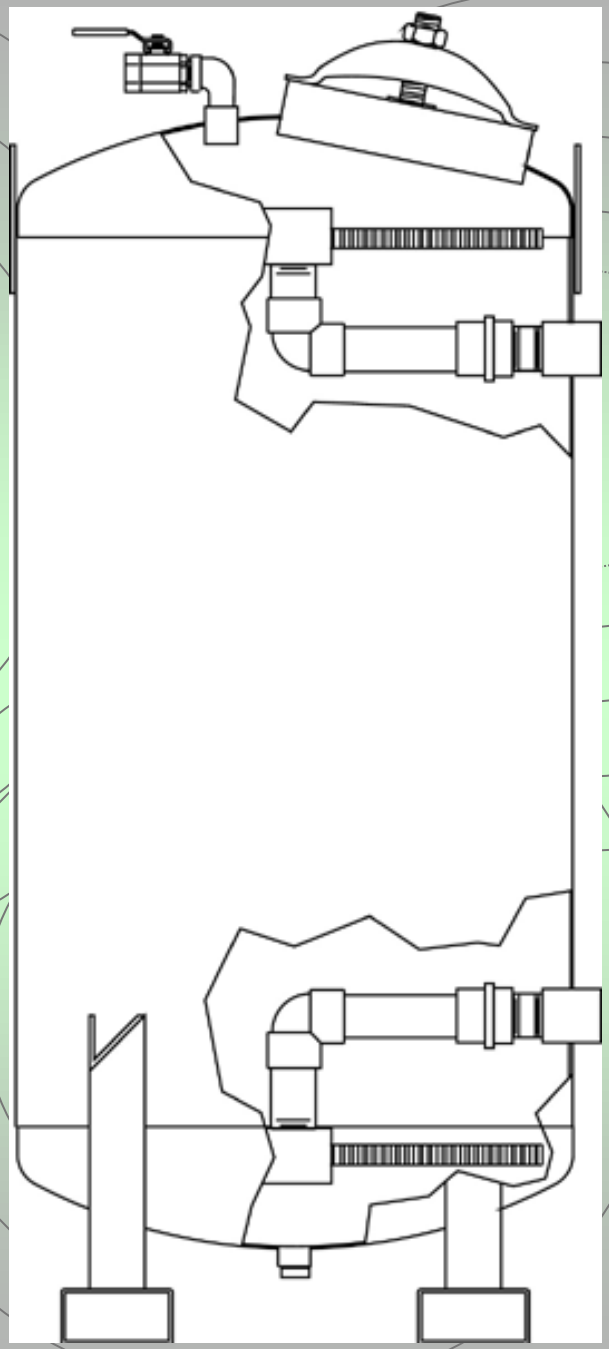
Granular Activated Carbon Columns

GAC Silos

Gas Purification

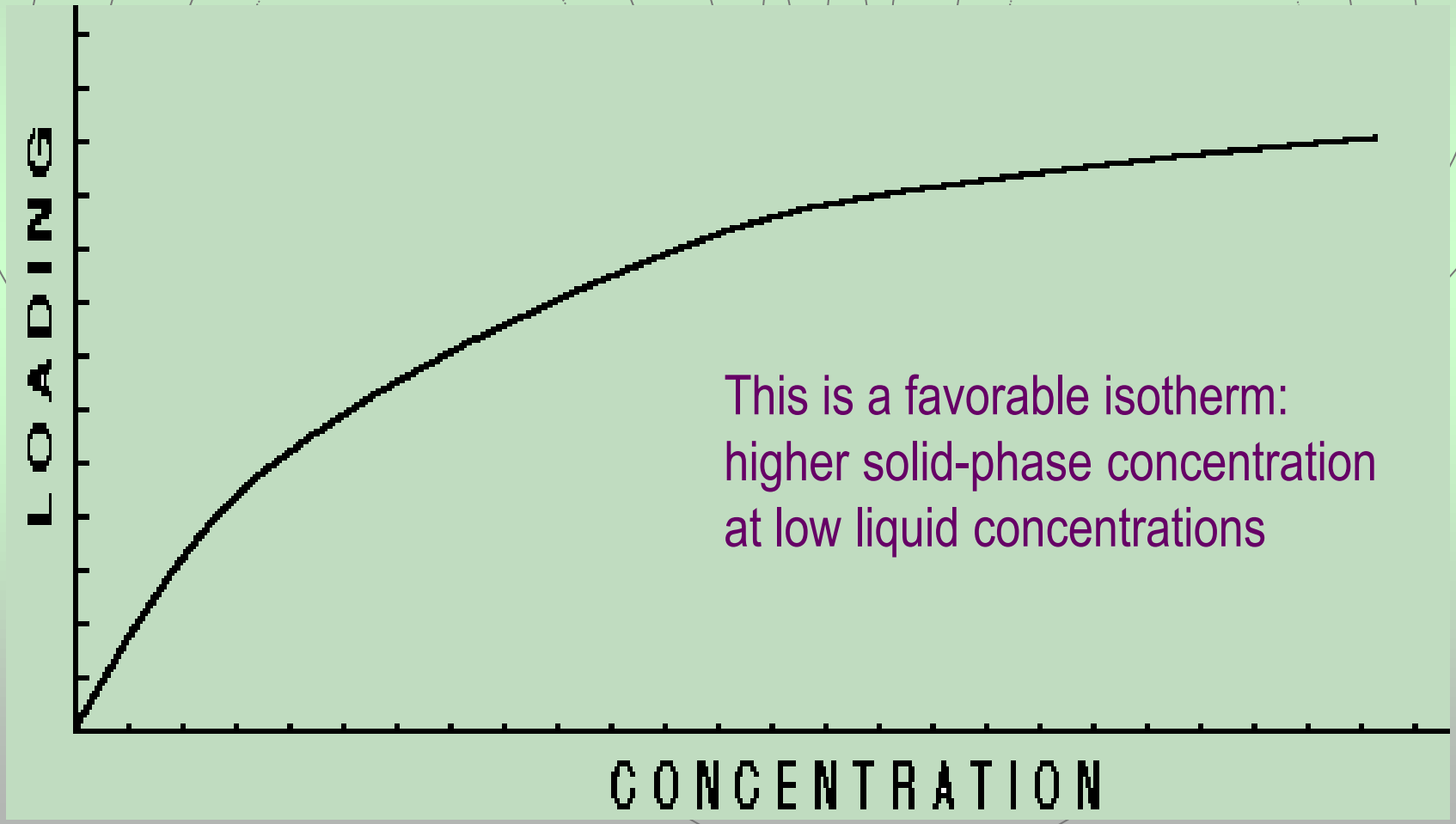


Contacting Column Internals

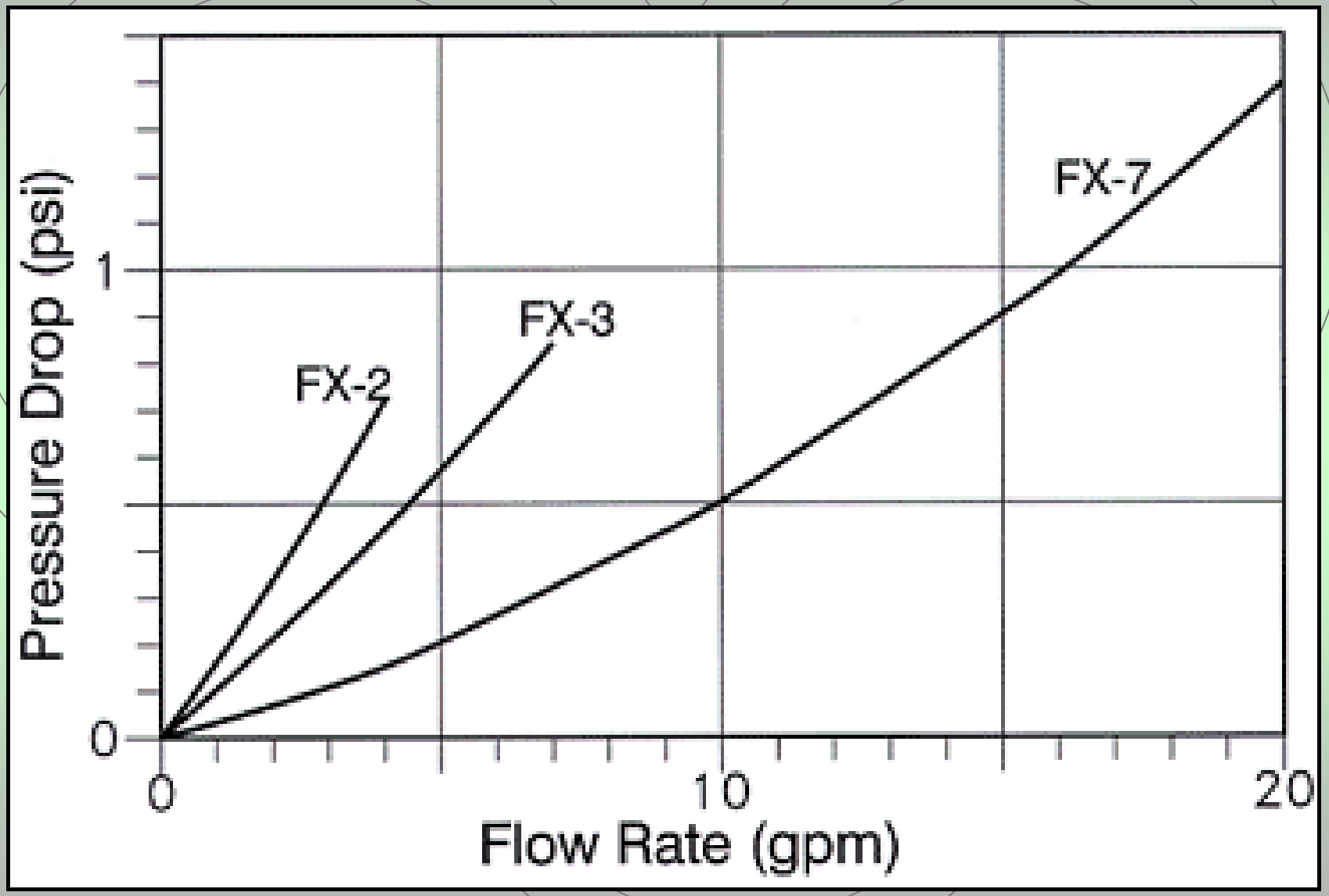


Typical isotherm

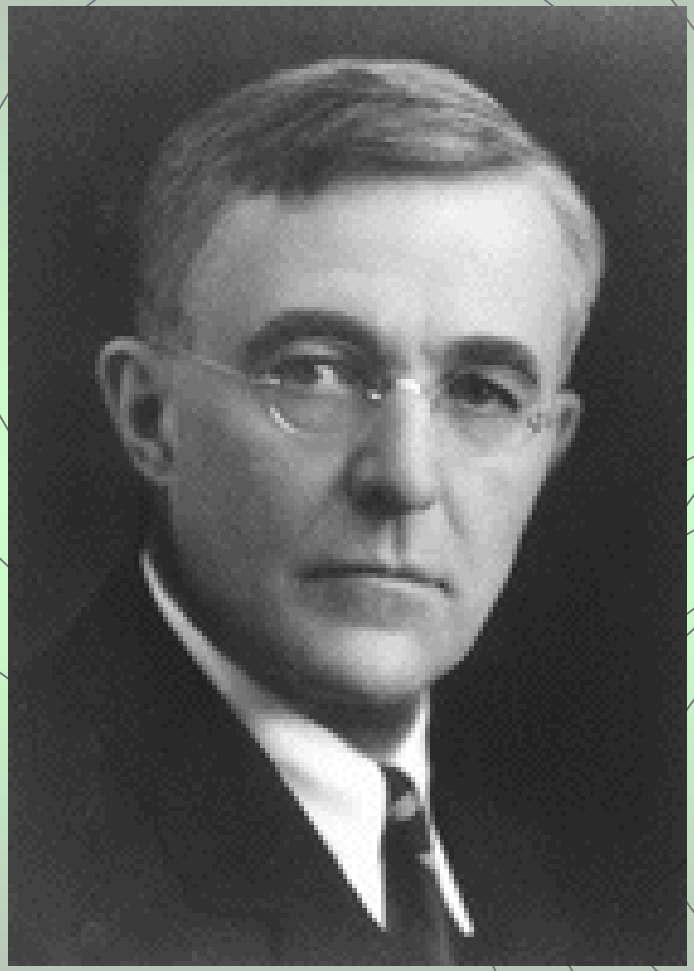
solid-phase concentration (y-axis) vs liquid phase concentration (x-axis)



Column Hydraulics

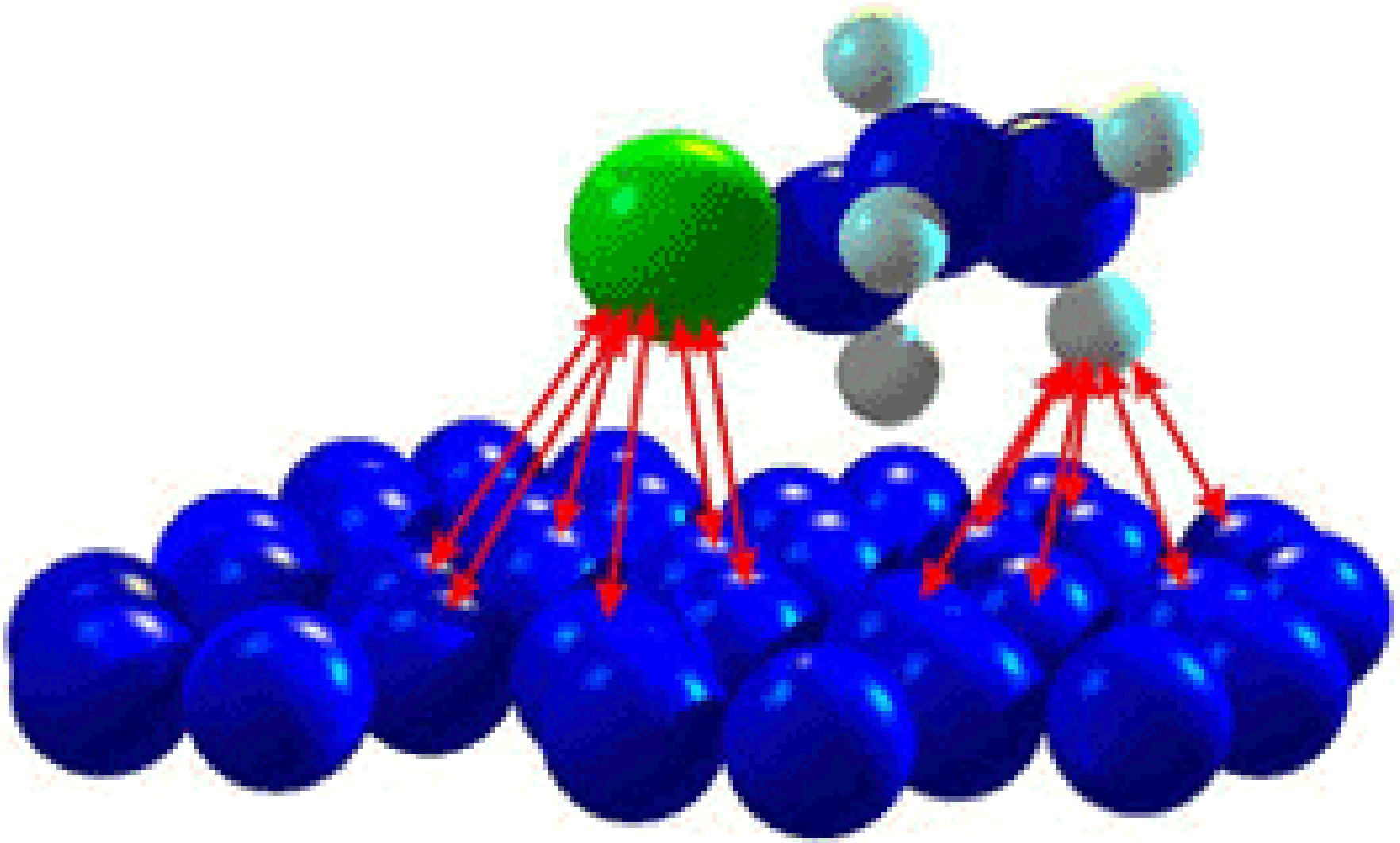


Which of these two “twins” pioneered adsorption modeling?



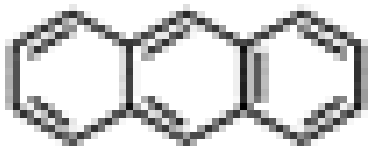
Langmuir!

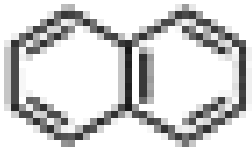
Adsorptive Forces

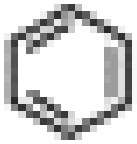


The effect of molecular size and functional groups on adsorbability

increasing adsorbability







- C = C - C = C -

- C ≡ C -

- C - C -

OH
|
- C = O

- C = O

- C - O - C -

- C - OH

- C - H

- C - I

- C - Br

- C - Cl

- C - H

- C - F

- C - SH

- C - CH_3

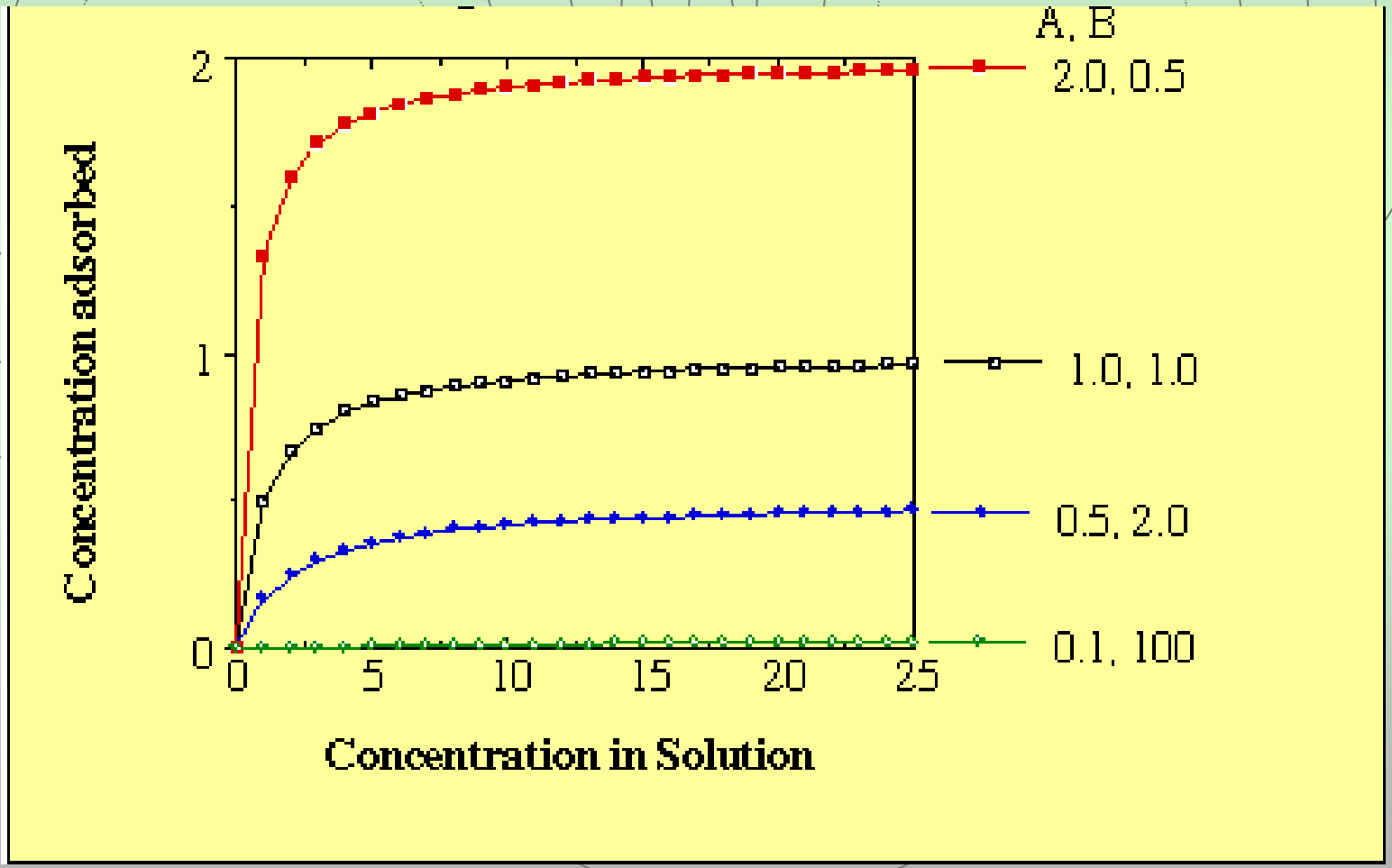
- C - NH_2

- C - OH

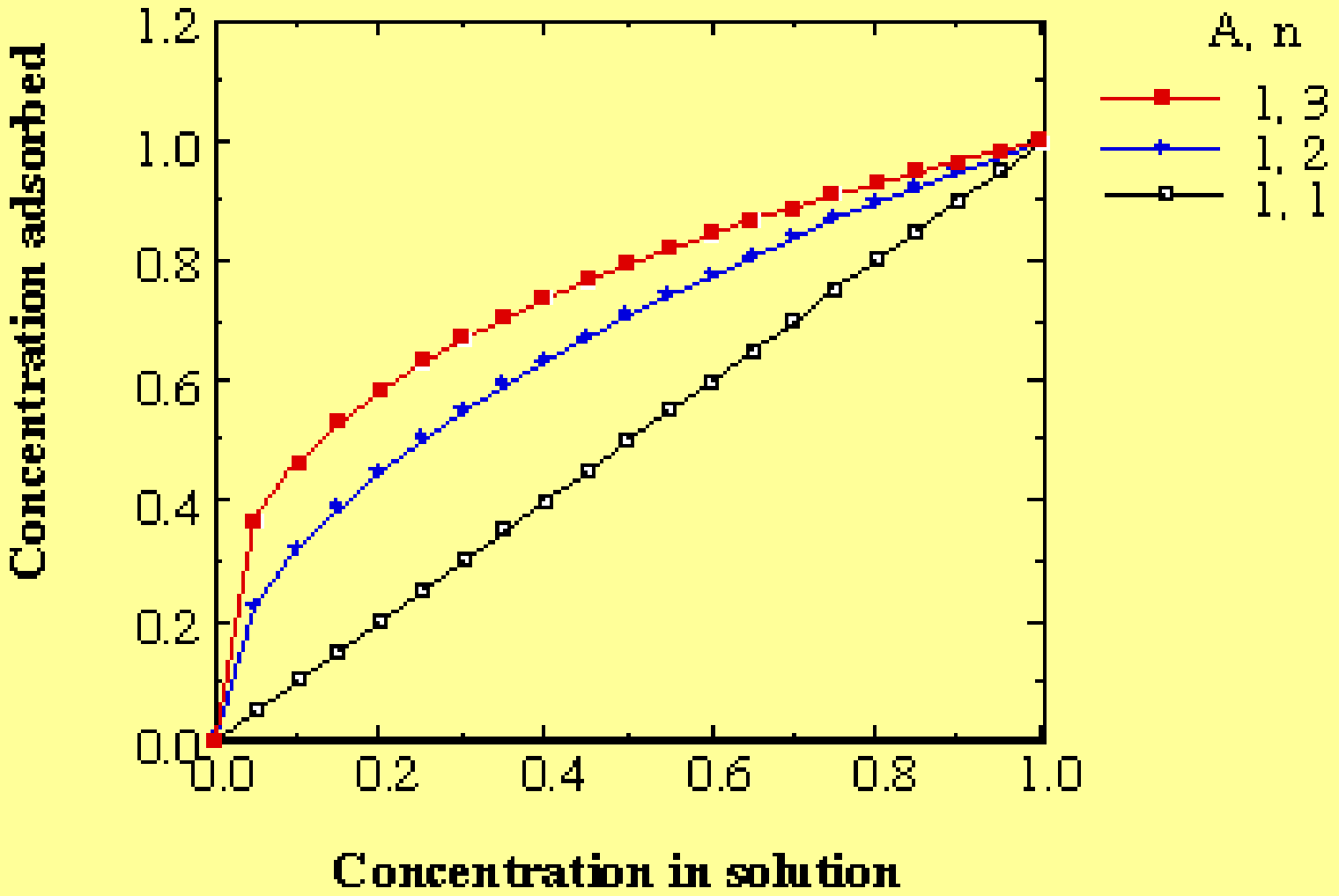
- C - F

Langmuir isotherm

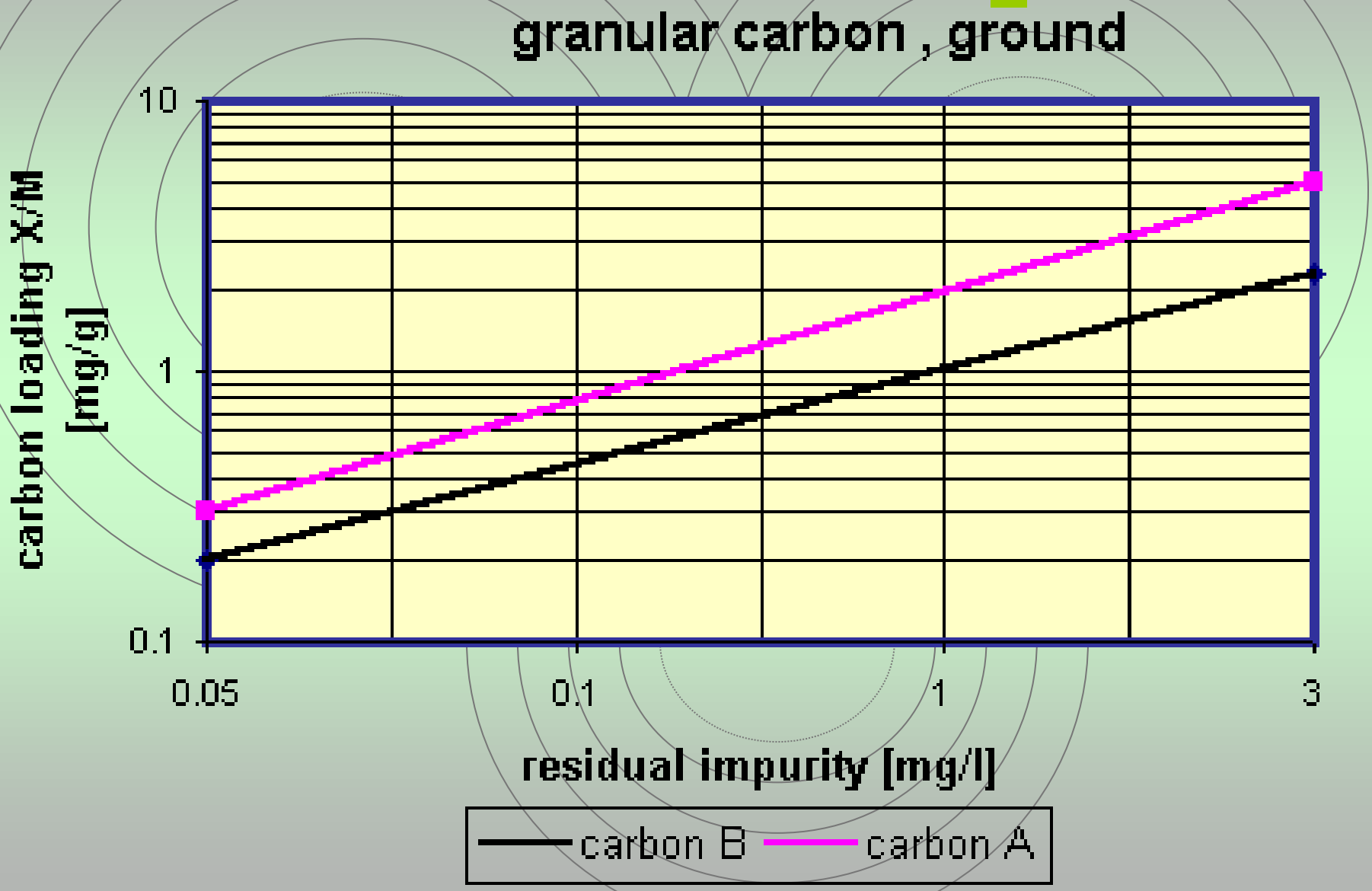
$$\bar{C} = \frac{A\,C}{B + C}$$



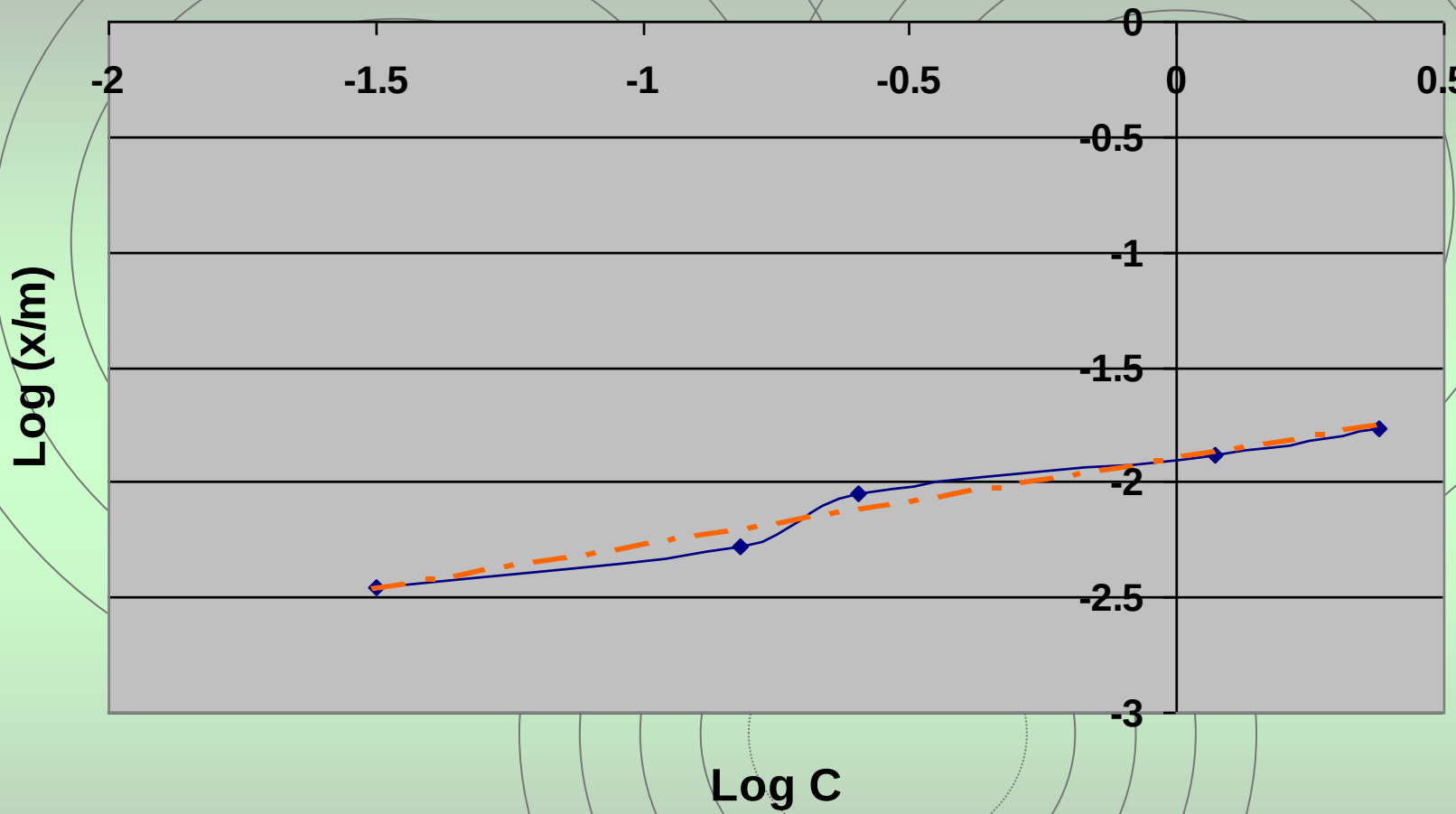
Freundlich isotherm (linear scale)



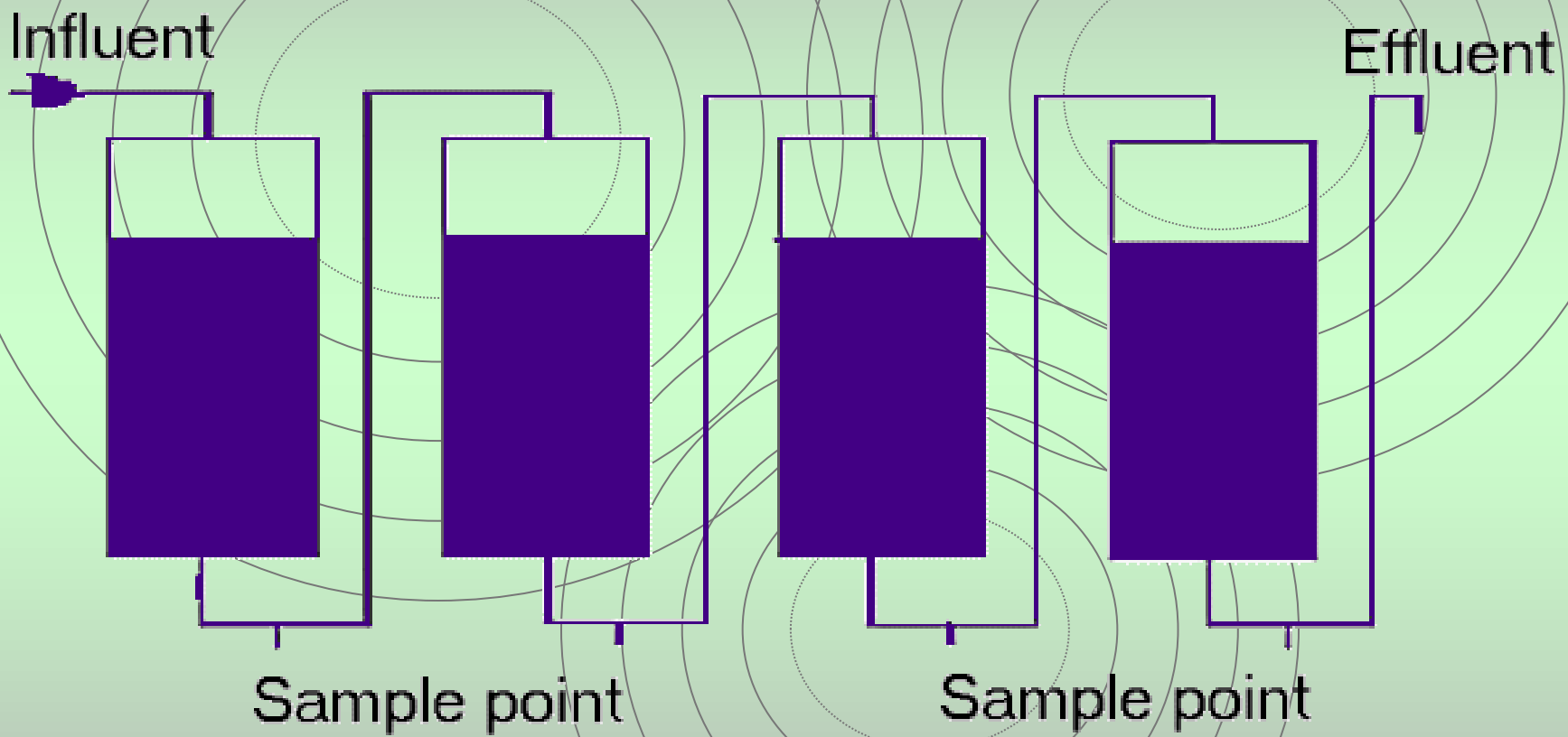
Freundlich isotherm, log-log scale



Freundlich isotherm, compared with real data

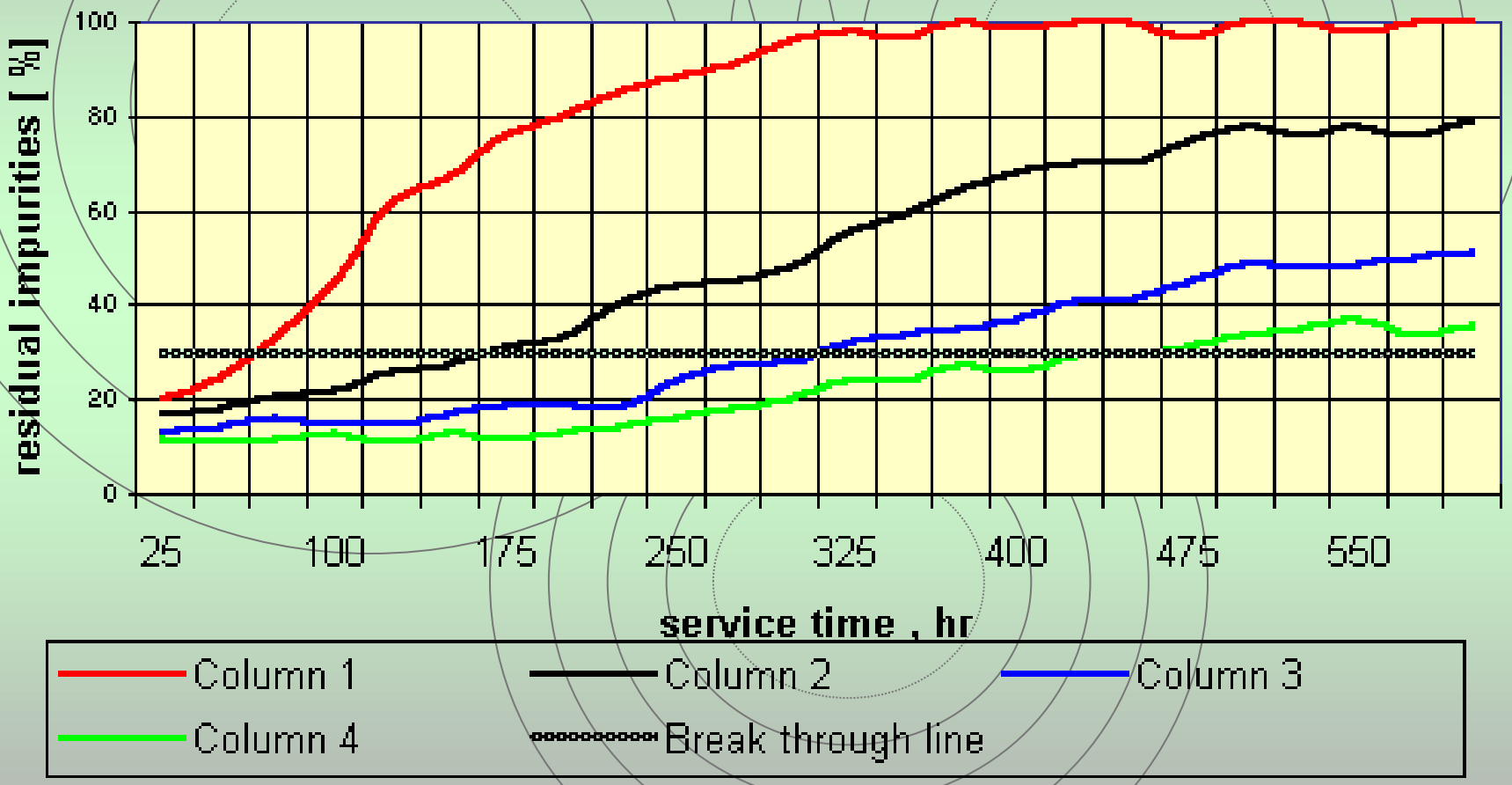


Four GAC columns in series

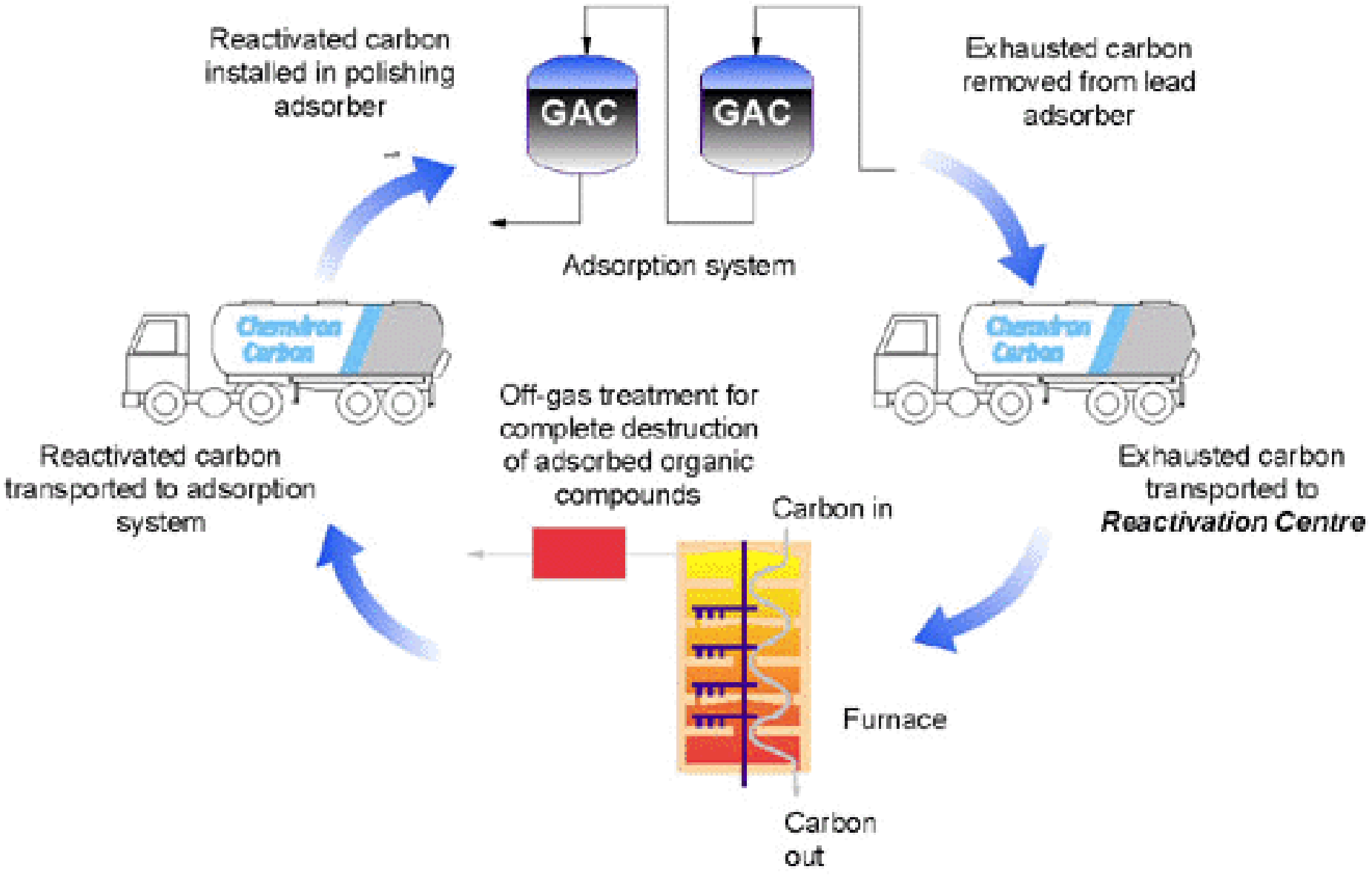


Break through curve

4 colums operating in series



REACTIVATION OF ACTIVATED CARBON



Transport of GAC

Decentralized Multiple Hearth Regeneration Facility