

# Activated Carbon Derived From Pine Cone With High Water Adsorption Capacity

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## 1 Environmental problem by air conditioning

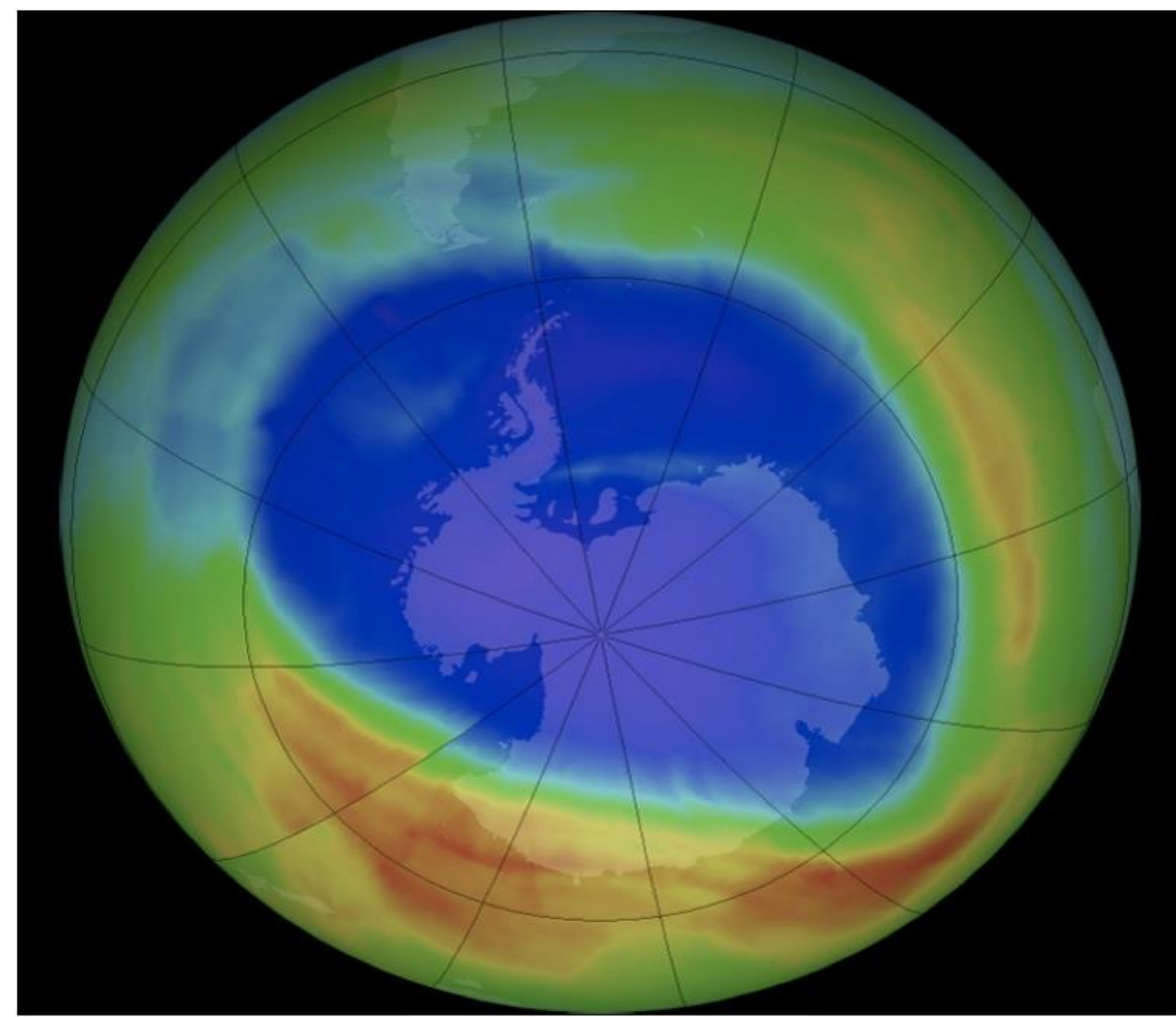
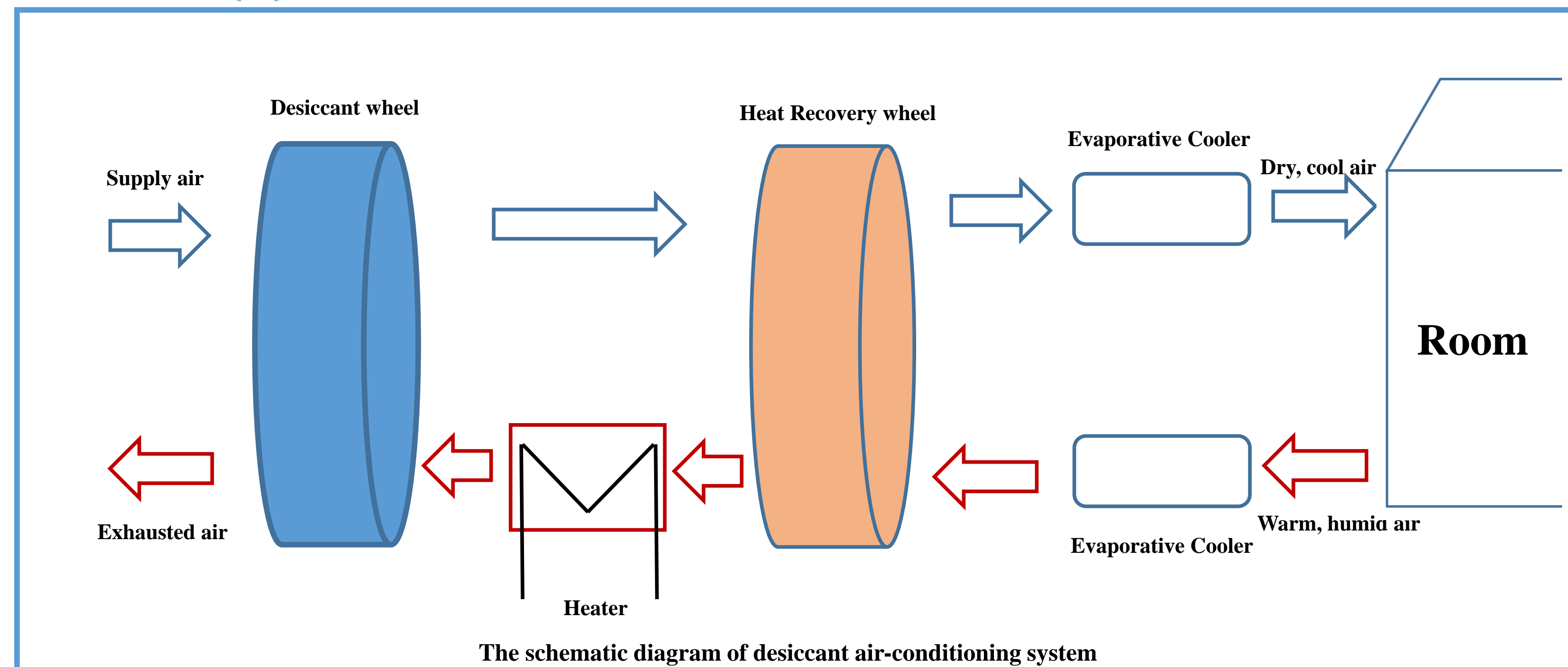


Image of Ozone hole by NASA

### Problem :

- Ozone hole caused by the refrigerant.
- High fossil energy consumption and carbon emissions.
- Global warming caused by the greenhouse effect.

## 2 Desiccant air-conditioning system (DAC)



The schematic diagram of desiccant air-conditioning system

### Advantages of DAC system:

- Eco-friendly, no ozone-depleting refrigerant.
- Energy saving by removing latent heat.
- Waste heat recovery and utilization.

## 3 Desiccant materials for DAC system

### Several common desiccant materials:



### Why activated carbon :

- High water adsorption capacity.
- Tough structure for repeated utilization.
- High porosity and micro-pores distribution.
- Various precursor materials and very cheap.

## 4 Activated carbon (AC) from Pine cone by steam activation

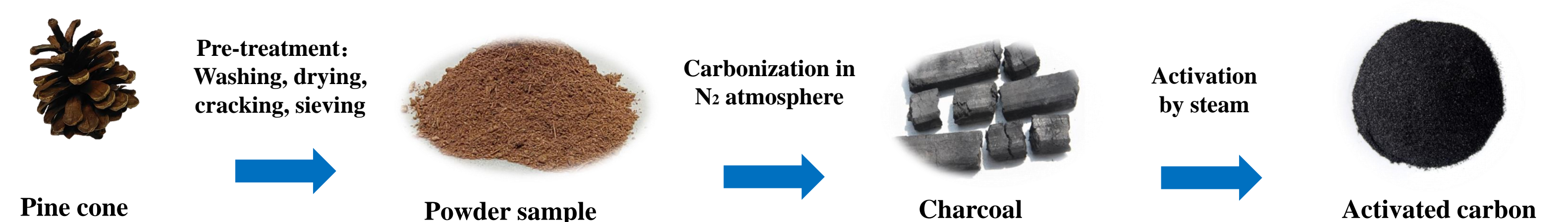
### Characteristics of pine cones:

- Low ash content
- High carbon content
- Cheap and forest waste utilization

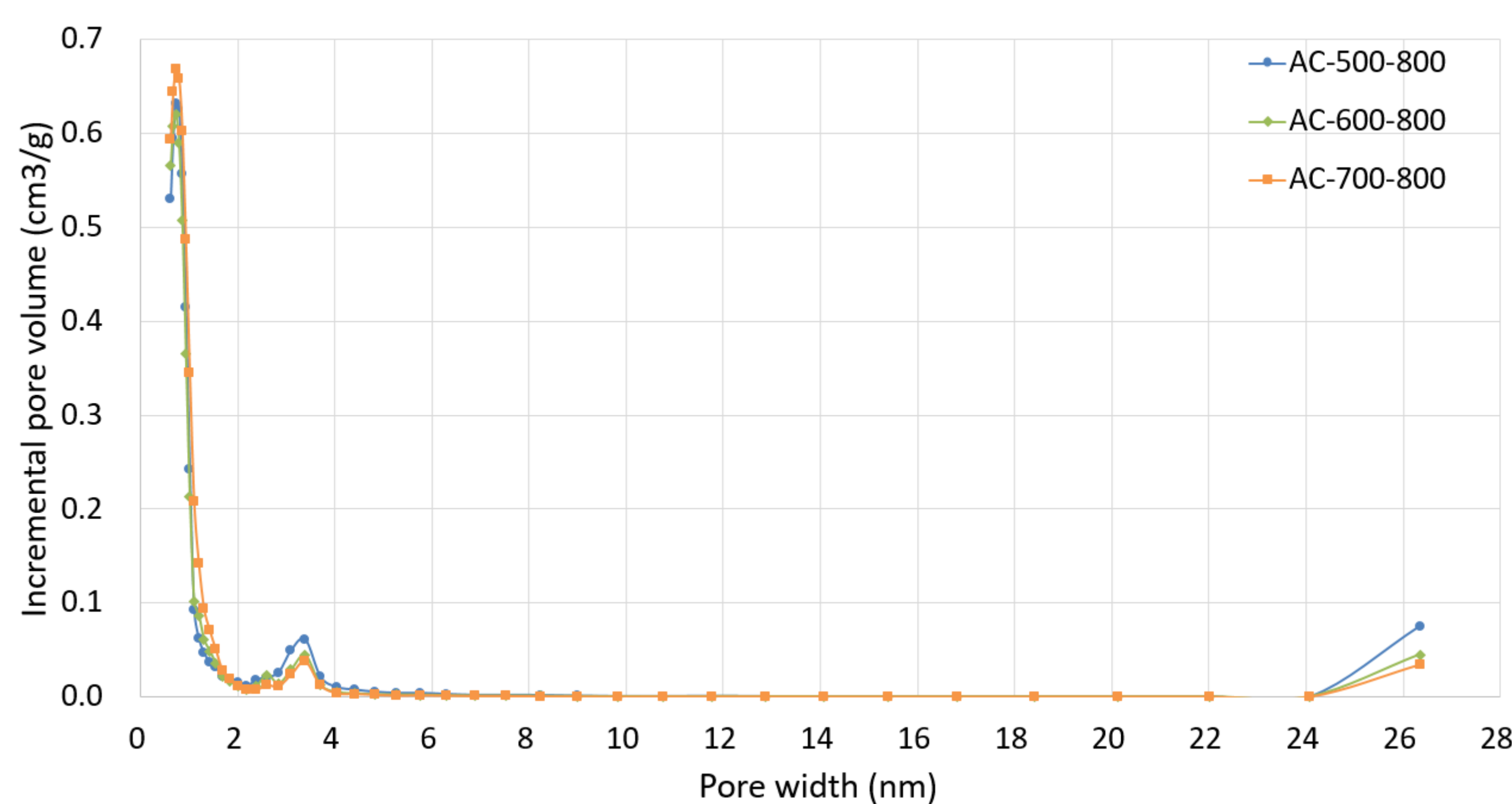


Precursor material of pine cone

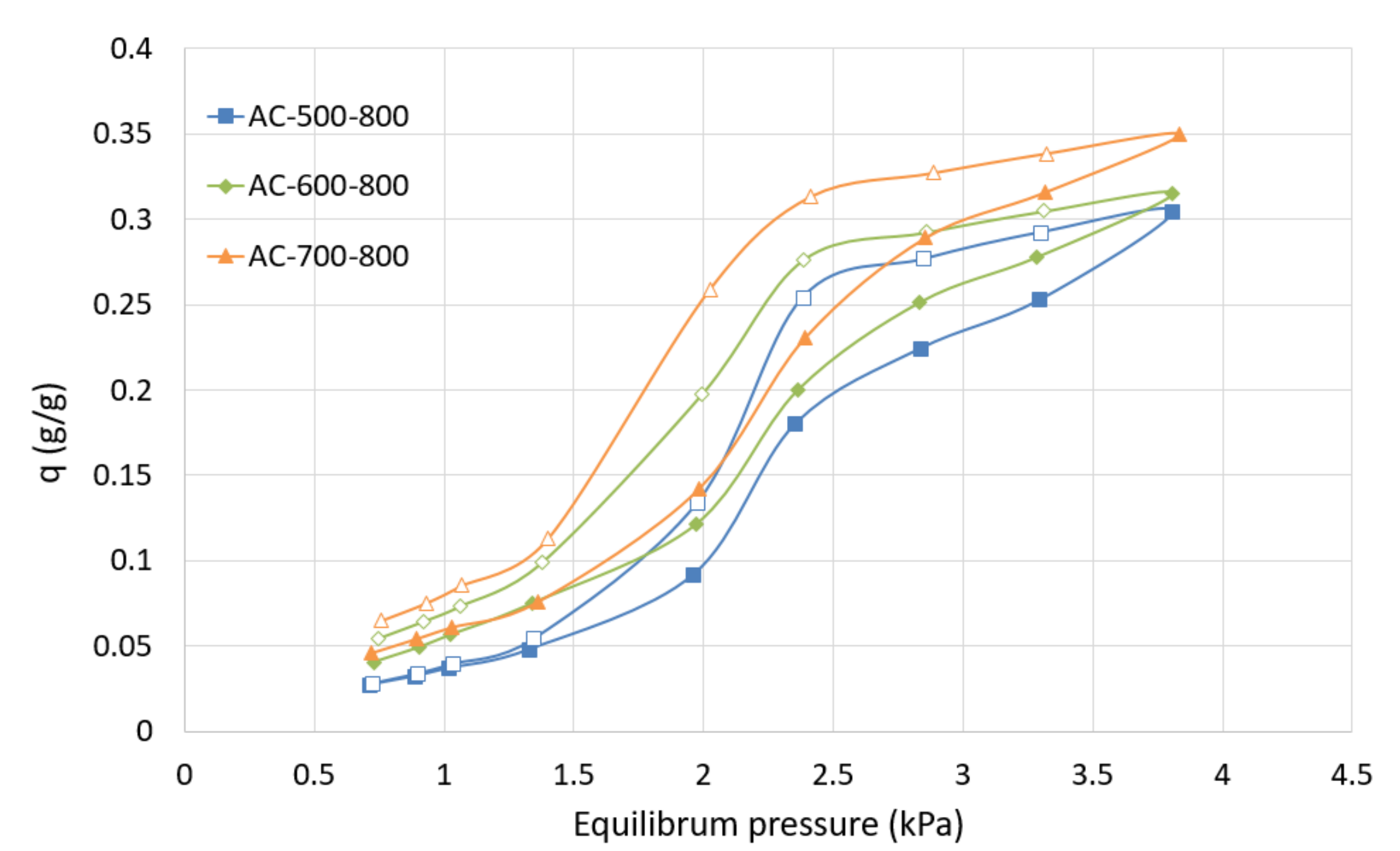
### The Activated carbon production process by steam activation:



## 5 Characterization of activated carbons derived from pine cone by steam activation



Pore size distribution of ACs



Water vapor adsorption-desorption isotherm of ACs at 303K

### Conclusion:

- The surface areas and pore volume of all samples are high, and sample AC-700-800 has largest surface area, micropore surface and micropore volume.
- The pore volume of 3 samples are almost contributed by micropore (the size of micro-pore is less than 2nm), and more micropores around 0.5 nm are detected.
- Activated carbon from 700°C carbonization (AC-700-800) has the highest water adsorption capacity of 0.34 g/g, maybe because AC-700-800 has most micropores.
- All activated carbon samples have a high water absorption capacity of more than 0.3 g/g. The activated carbon products from pine cone present a good potential as desiccant material.