九州大学 エネルギーウィーク 2022
Energy Week 2022

Kyushu University Platform of Inter-/Transdisciplinary Energy Research

Comparison Study of Activated Charcoal and Silica Gel in Dehumidification Technology

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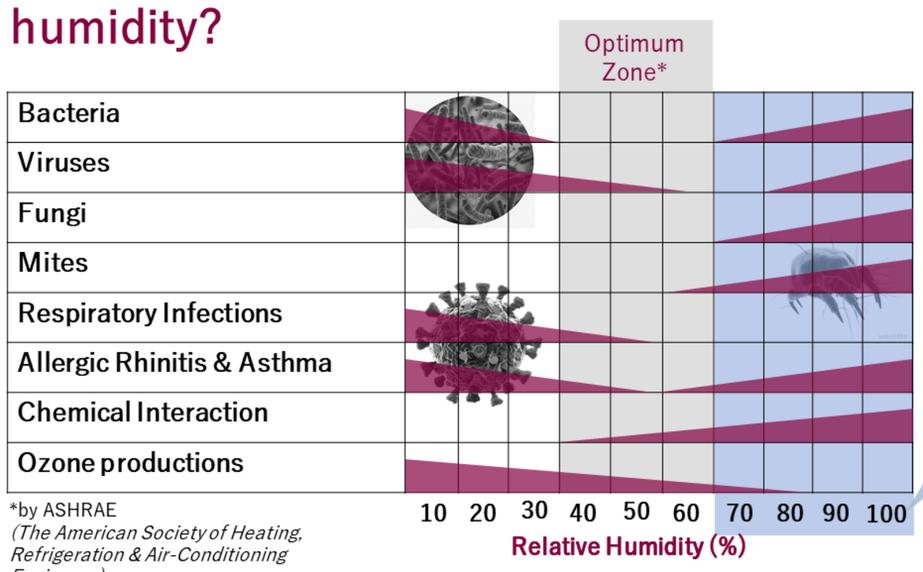
1 START HERE!

Do you know that most of troubles are caused by humidity?

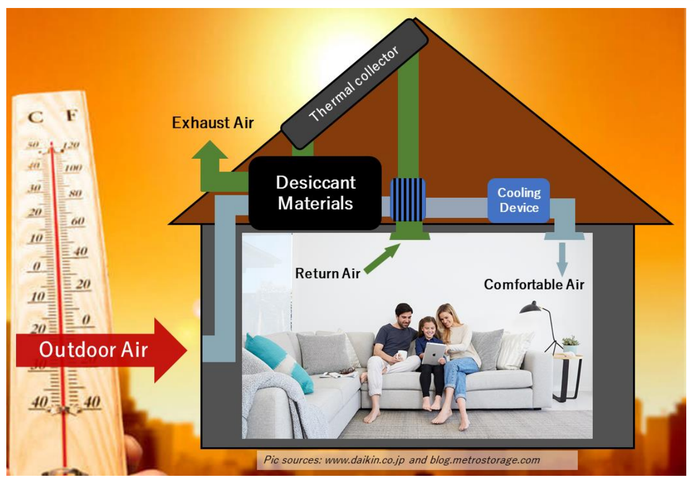


*by ASHRAE
(The American Society of Heating, Refrigeration & Air-Conditioning Engineers)

Ambient air conditions in tropical countries in a whole year or subtropical countries during summer

- Air dehumidification in tropical countries consumed >15% of total energy for building.
- Needed technology with lower energy consumption!

2 Thermal Adsorption Dehumidification



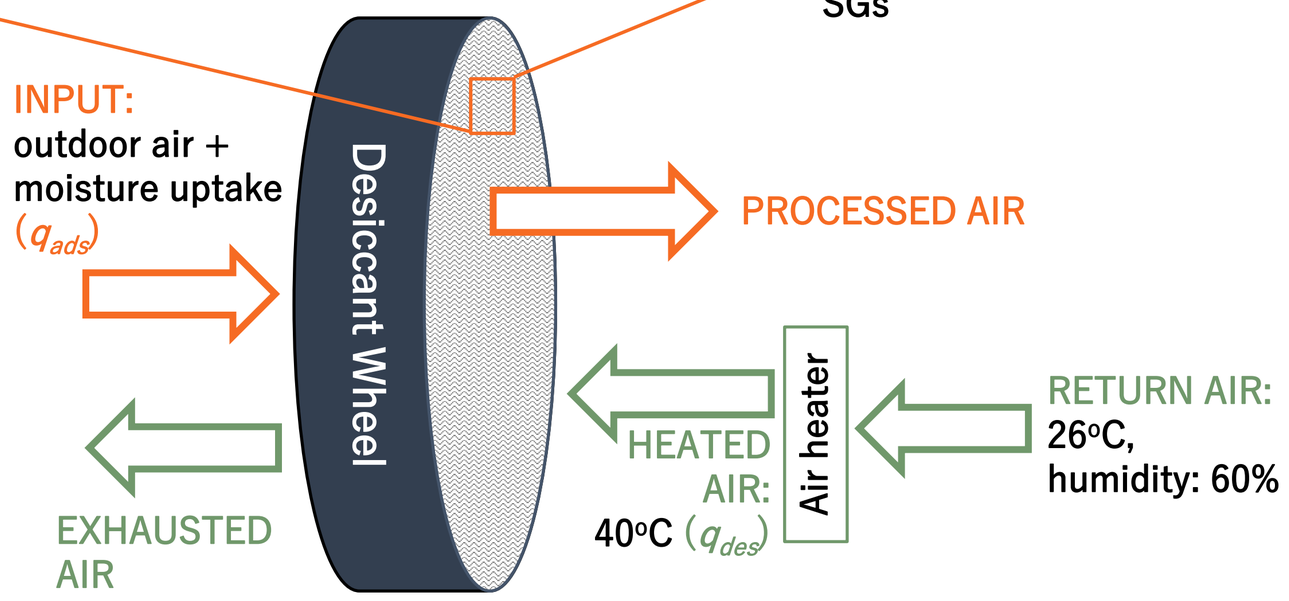
- Separate the humidity removal and temperature control.
- Provide 30 – 50% of energy saving.
- Desiccant material with low regeneration temperature is needed.

3 Desiccants

Activated charcoal (AC)
Source: goodhousekeeping.com

Silica Gel (SG)
Source: missouripoisoncenter.org

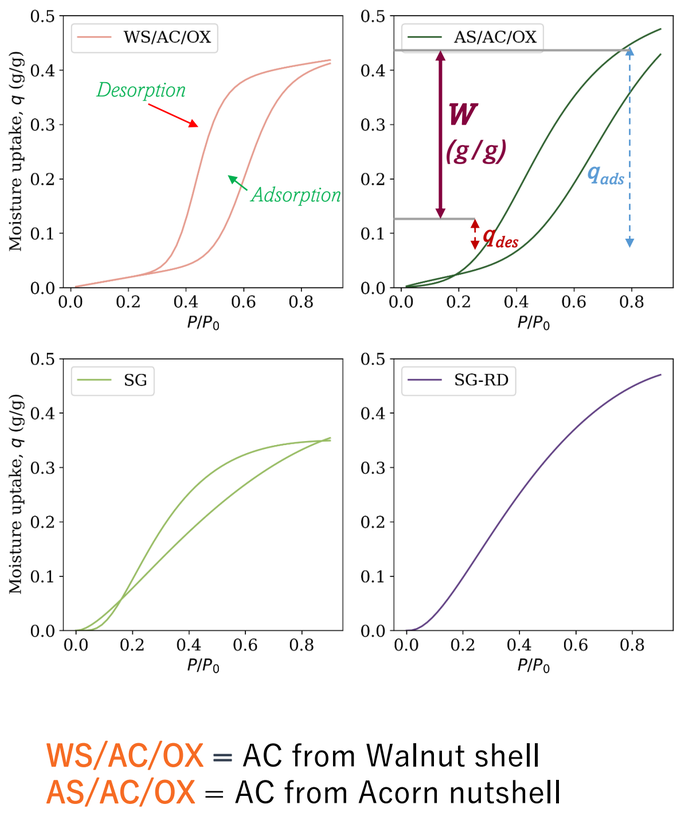
- Compared between dehumidification capacity (w) of ACs and SGs
- Different biomass-based ACs and commercialized SGs



$$w\,(g/g) = q_{ads} - q_{des}$$

4 Dehumidification Study

Adsorption Isotherm at 30°C



Ambient air condition:
30°C; RH 80% → P/P_0 = 0.79

Regeneration condition:
Indoor air standard
26°C; RH 60%
Treg = 40°C → P/P_0 = 0.26

P/P_0 = relative pressure of moisture in the air
q_{ads} (g/g) = adsorption uptake
q_{des} (g/g) = desorption uptake
w (g/g) = dehumidification capacity

WS/AC/OX = AC from Walnut shell
AS/AC/OX = AC from Acorn nutshell
SG = Silica Gel from Kishida Chem. Co., Ltd.
SG-RD = Silica Gel from Fuji Silysia, JP.

Using conditions above

Materials	Dehumidification capacity, w (g/g)
WS/AC/OX	0.35
AS/AC/OX	0.28
SG	0.17
SG-RD	0.29

***Pore properties of materials**

Materials	Surface Area (m^2/g)	Pore Volume (cm^3/g)	Pore Size (nm)
AS/AC/OX	1250	0.65	1.07
WS/AC/OX	2239	0.93	0.84
SG	618	0.37	1.24
SG-RD	780	0.44	2.24

5 Summary

- Different materials has various surface properties
- Different properties → different moisture uptake
- Biomass based-ACs show promising dehumidification capacity under humid condition