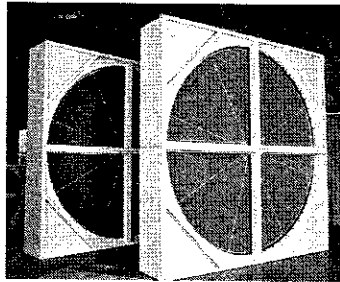


2008 AIChE Annual Meeting

Philadelphia, PA



## Comparison of Odor Transfer Characteristics of Total Heat Exchangers Between Ion Exchange Resin and Porous Adsorbent as Desiccant



Hiroshi Okano,  
Tsutomu Hirose,  
Wei-Li Jin.

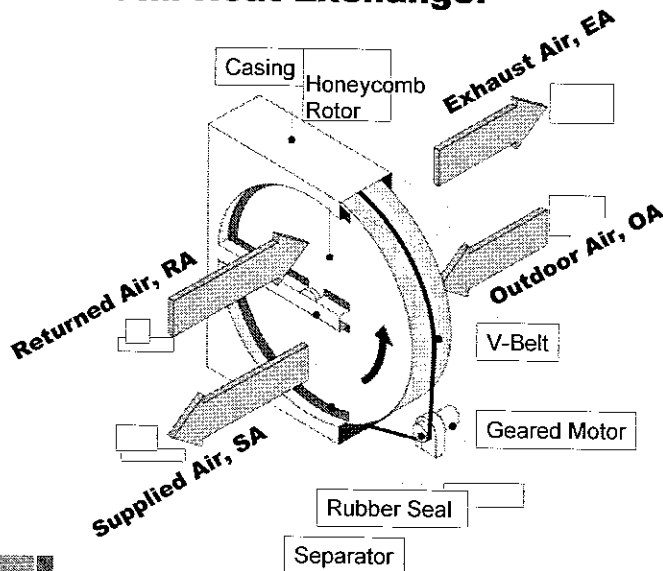
**Seibu Giken Co., Ltd.**

3108-3, Aoyagi, Koga, Fukuoka, Japan

E-mail [info@seibu-giken.co.jp](mailto:info@seibu-giken.co.jp)

URL <http://www.seibu-giken.co.jp>

## Honeycomb Rotor Total Heat Exchanger

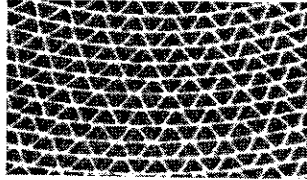


- ◆ A total heat exchanger is an energy saving device used in the ventilation and air conditioning.
- ◆ It exchanges and recovers both sensible heat (temperature) and latent heat (humidity) simultaneously.
- ◆ In a typical example, 26% of the air conditioning load is saved among the total load of 75.2Mcal/m<sup>2</sup>

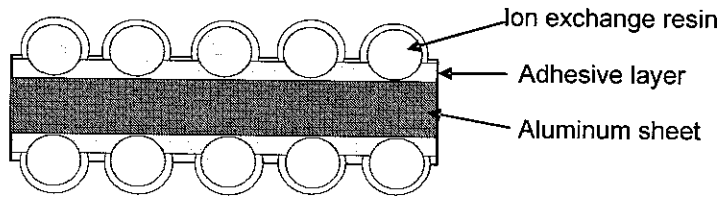
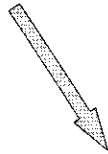
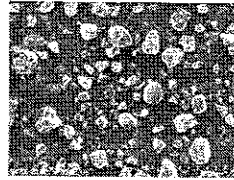
## Honeycomb Structure



Honeycomb structure

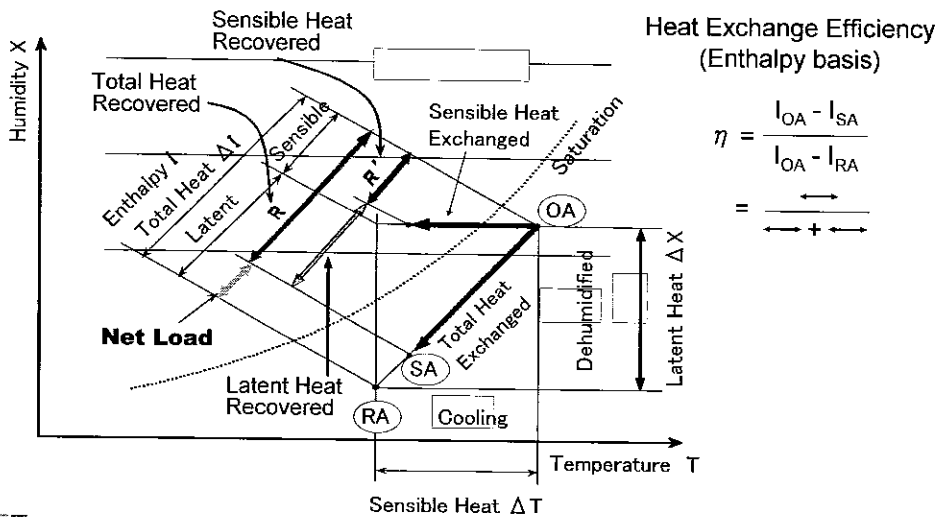


Surface of sheet



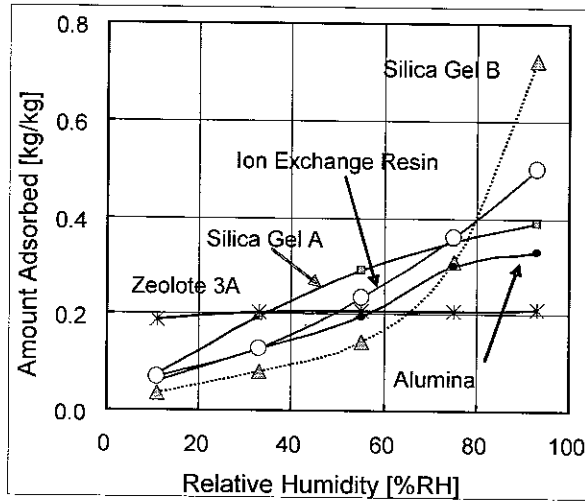
Both side of aluminum sheet is coated with desiccant particles to give an ability of the latent heat (humidity) exchange.

## Sensible, Latent and Total Heats Recovered



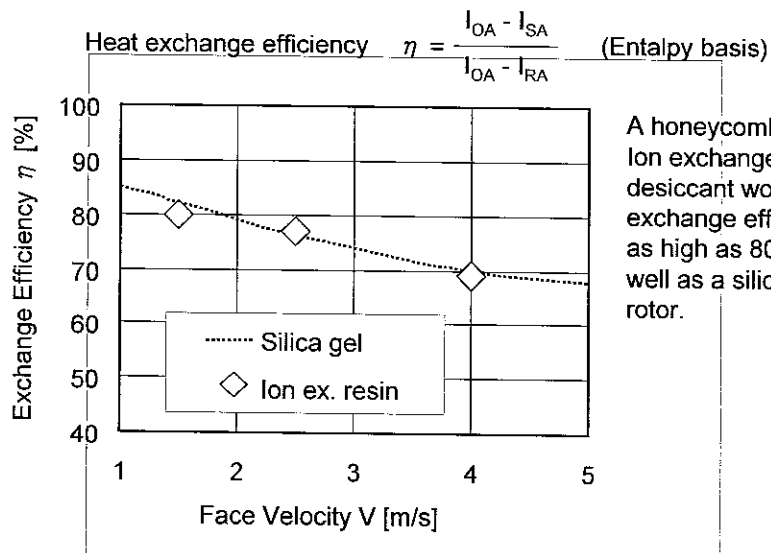
Presentation on a humidity chart (Cooling case)

## Adsorption Isotherm of Water Vapor



Ion exchange resin is as good desiccant as porous adsorbents

## Heat Exchange Efficiency



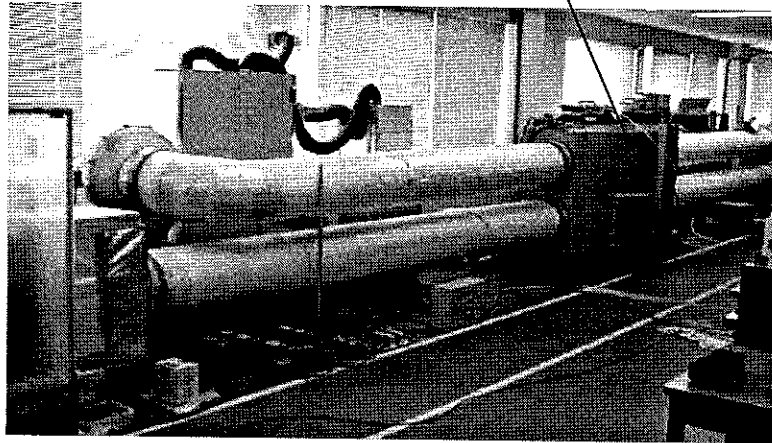
A honeycomb rotor of Ion exchange resin as desiccant works with exchange efficiency as high as 80% as well as a silica gel rotor.



## Odor Transfer Test



Test Rotor: 950 mm dia.



Transfer Ratio

$$F = \frac{C_{SA} - C_{OA}}{C_{RA} - C_{OA}}$$

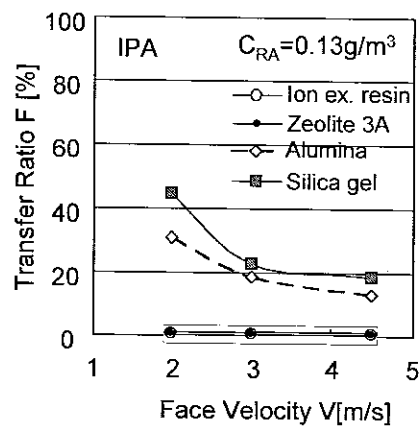
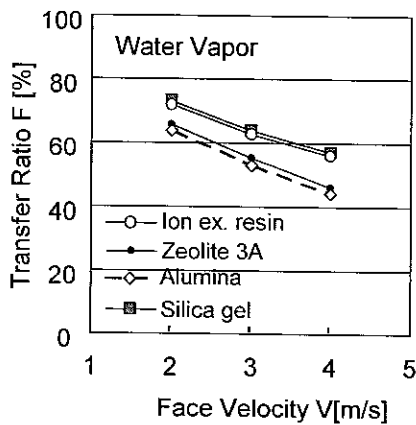
Specific Transfer Rate

$$R = (C_{SA} - C_{OA})Vt_c$$

### Transfer Ratio F (1) Water Vapor and IPA



$$\text{Transfer Ratio } F = \frac{C_{SA} - C_{OA}}{C_{RA} - C_{OA}}$$

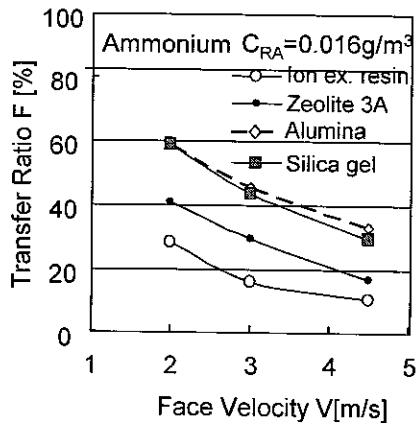


◆ The ion exchange resin rotor gives the highest transfer ratio for water vapor as well as silica gel.

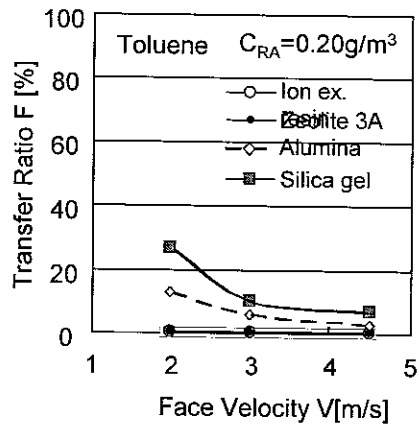
◆ The ion exchange resin rotor rejects the odor transfer of iso-propyl alcohol (IPA) completely.

## Transfer Ratio F (2) Ammonium and Toluene

$$\text{Transfer Ratio } F = \frac{C_{SA} - C_{OA}}{C_{RA} - C_{OA}}$$



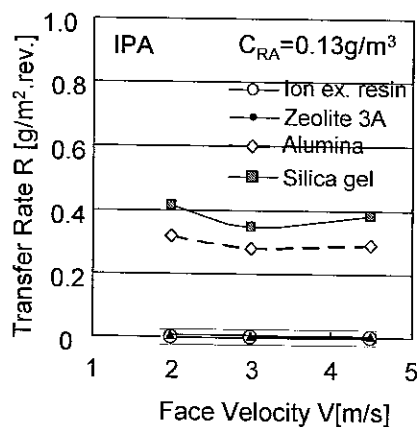
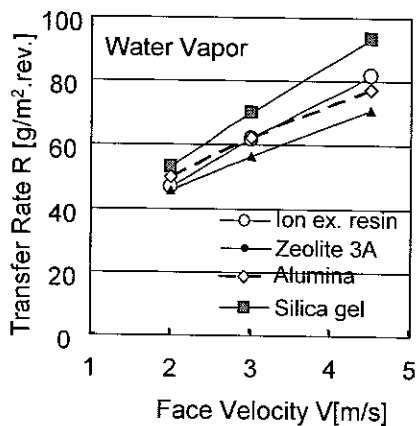
- ◆ The ion exchange resin rotor has the lowest transfer ratio for ammonium.



- ◆ The ion exchange resin rotor rejects the odor transfer of toluene completely.

## Specific Transfer Rate R (1) Water Vapor and IPA

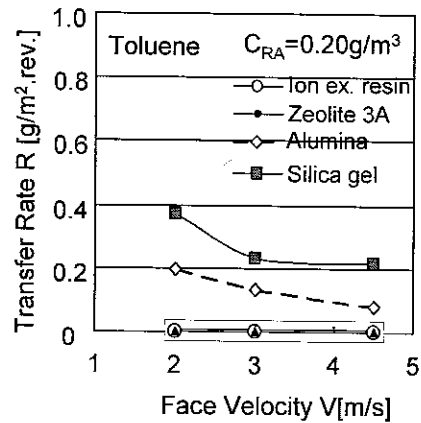
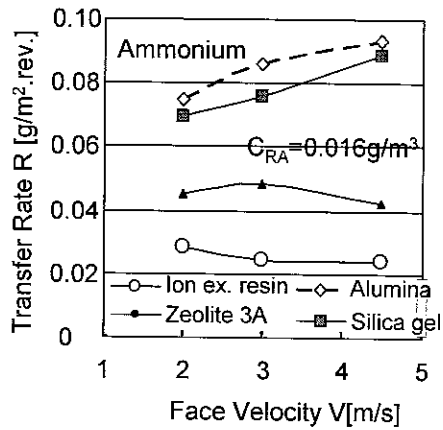
$$\text{Specific Transfer Rate } R = (C_{SA} - C_{OA})Vt_c$$



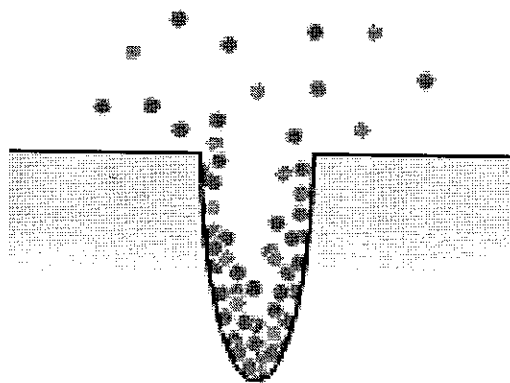
## Specific Transfer Rate R (2) Ammonium and Toluene



$$\text{Specific Transfer Rate } R = (C_{SA} - C_{OA})Vt_c$$



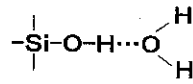
## Odor Adsorption on Porous Adsorbent



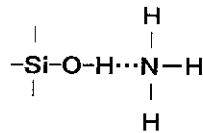
- ◆ Porous adsorbents adsorb odor substances together with water vapor by capillary force.
- ◆ Odor substances are desorbed by replacement adsorption in a rapid increase of humidity.

- Water molecule
- Odor molecule

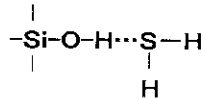
## Odor Adsorption on Silanol Group



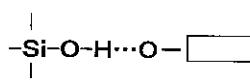
(Moisture)



(NH<sub>3</sub>, Amines)



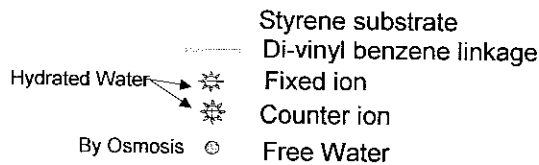
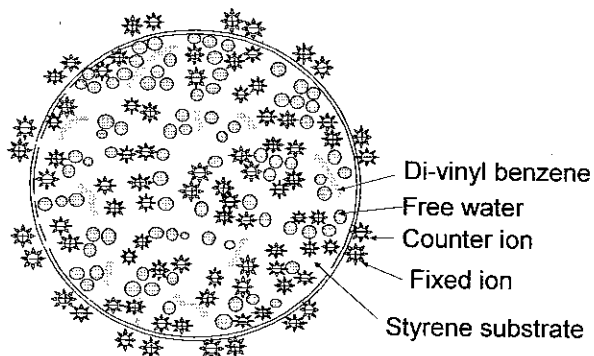
(H<sub>2</sub>S, Mercaptan, Sulfur compounds)



(Alcohol, Ether, Carbonyl, etc.)

◆ Silanol group has a strong adsorbing ability for water vapor and adsorbs odor as well.

## Structural Model of Ion Exchange Resin

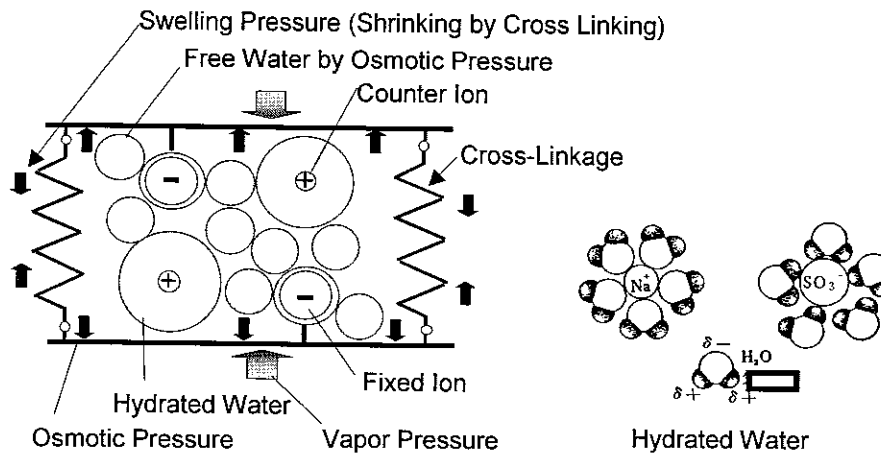


◆ The shrinking force due to crosslinkage and the swelling force due to hydration and osmotic pressure are balanced inside the resin.

◆ Even a water soluble odor substance is difficult to be solved into water inside resin due to this high interior pressure



## Swelling and Osmotic Pressure in Ion Exchange Resin



W.Buser, P.Graf and W.F.Grutter; Chimia, 9, 73 (1955)

## Summary



- ◆ Total (sensible and latent) heat exchangers have been widespread as an energy saving appliances.
- ◆ One of customers' complaints is the odor transfer happening in an early rainy season. It is caused by adsorption of odor substances in the adsorption step and accelerated desorption due to replacement adsorption of water in case of porous adsorbents.
- ◆ We have developed a honeycomb rotor by use of non-porous ion exchange resin, which has high desiccant ability but rejects odor substances.
- ◆ Seibu Giken Co., Ltd has commercialized a new type of the total heat exchanger with a trade name of **HI-PANEX ION**
- ◆ **HI-PANEX ION** was awarded the 2004 technology prize by the Japan Society of Adsorption.

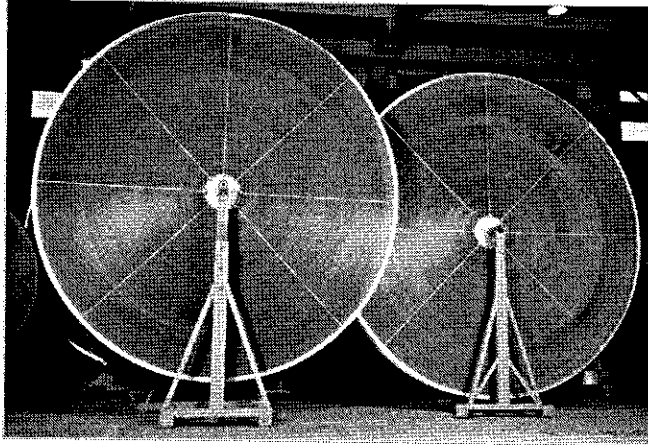
## SG Products



Ion Adsorption Type

Total Heat Exchanger **HI-PANEX-ION**

### ● Photographs



Total heat exchange rotor

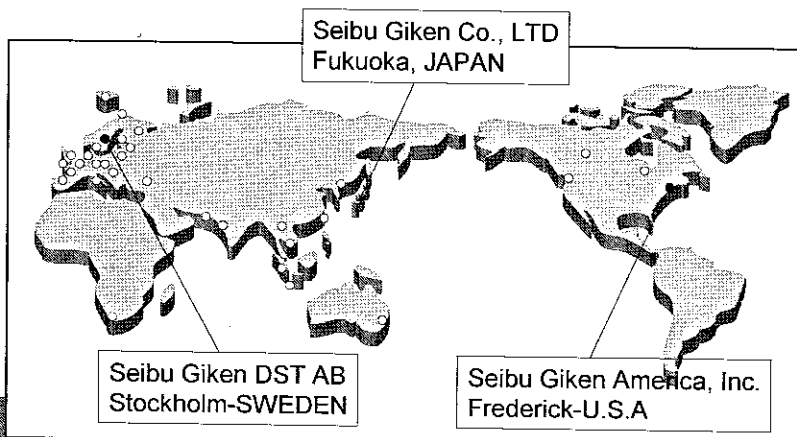
Material : Aluminum  
Φ 3900 × 200mm

## SG Company Profile



# Global Communication

We export our products to more than 30 overseas countries.



- 21 European countries
- U.S.A.
- Korea
- China
- Taiwan
- Australia
- Canada
- Singapore
- Thailand
- Malaysia
- India
- Vietnam
- Pakistan
- others