

# Cross-Contamination Test of the Seibu-Giken “HI-PANEX-Ion” Enthalpy Wheel

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Enthalpy exchangers have been widely used for achieving comfortable air-conditioning with lower energy consumption. Desiccant materials such as silica gel and molecular sieves are used so as to give it a latent heat exchanging function. However, this important function has become the cause of cross-contamination because the substances with an offensive odor are also adsorbed in the desiccant. In this report, cross-contamination of an enthalpy wheel consisting of ion-exchange resin particles as a desiccant material “HI-PANEX-Ion” was examined and the results were compared with those of a commercialized 3A molecular sieve wheel. It was found that the “HI-PANEX-Ion” wheel showed smaller cross-contamination ratio than the 3A molecular sieve wheel for all the contaminants tested in this study.

## 1 . HI-PANEX-Ion Enthalpy Wheel

Special feature of the HI-PANEX-Ion enthalpy wheel is employment of an ion exchange resin as a desiccant. At first, fine particles of a strongly acidic cation exchange resin, which is linear polymers of styrene cross-linked by divinyl benzene containing sulfonic acid radicals (SO<sub>3</sub>H) and sodium ions (Na<sup>+</sup>) as counter ion, were sprayed and adhered rigidly to aluminum sheet coated with a kind of binder. Then, it was treated with anti-bacterial and anti-mold coating as shown in Figure 1. Finally, the aluminum sheet was corrugated and made into a honeycomb wheel.

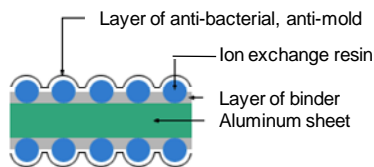


Fig. 1 A sectional drawing of the wheel element of HI-PANEX-Ion Enthalpy Exchanger.

## 2 . EXPERIMENTAL

All experiments and calculations were strictly conducted by ANSI/ASHRAE approved Standard 84-2008 “Method of Testing Air-to-Air Heat/Energy Exchangers” and ARI 1060-2005 “Performance Rating of Air-To-Air Heat Exchangers for Energy Recovery Ventilation Heat Equipment”. A schematic diagram of the experimental set-up is shown in Figure 2. Seibu Giken HI-PANEX-Ion enthalpy wheel and the purchased 3A molecular sieve enthalpy wheel were provided for the cross-contamination test. Experimental condition was summarized in Table 1. Also, contaminants used for the cross-contamination test were ammonia, Carbon Dioxide, formaldehyde, Isopropanol, MIBK, p-Xylene and Propane. Gas chromatography and gas detector tubes were employed to detect the contaminants.

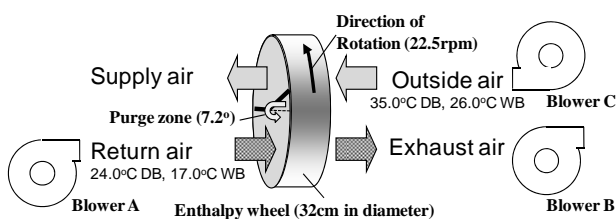


Fig. 2 Schematic diagram of the experimental set-up

Table 1 Experimental condition

Outside air condition	35.0 °C Dry-bulb, 26.0 °C Wet-bulb
Return air condition	24.0 °C Dry-bulb, 17.0 °C Wet-bulb
Purge zone angle	7.2 °
Rotation speed of wheel	22.5 rpm
Superficial velocity of air	3 m/s
RA/SA air flow ratio	1
Pressure difference SA-RA	0 or 250 Pa

## 3 . RESULTS

Cross-contamination ratio  $X$  was calculated by the following equation.

$$X = (C_{SA} - C_{OA}) / (C_{RA} - C_{OA}) \times 100 [\%]$$

where  $C_{SA}$ ,  $C_{OA}$  and  $C_{RA}$  show the concentration of contaminant [ppm] in supply air, outside air and return air, respectively. Cross-contamination tests are summarized in Figure 3. It was found that the HI-PANEX-Ion enthalpy wheel showed two - fifteen times smaller cross-contamination ratio than that of the 3A molecular sieve wheel. Among the tested contaminants, water-soluble ones, ammonia, formaldehyde and Isopropanol showed somewhat higher cross-contamination ratio than others, but those values were much smaller than those of the 3A molecular sieve wheel.

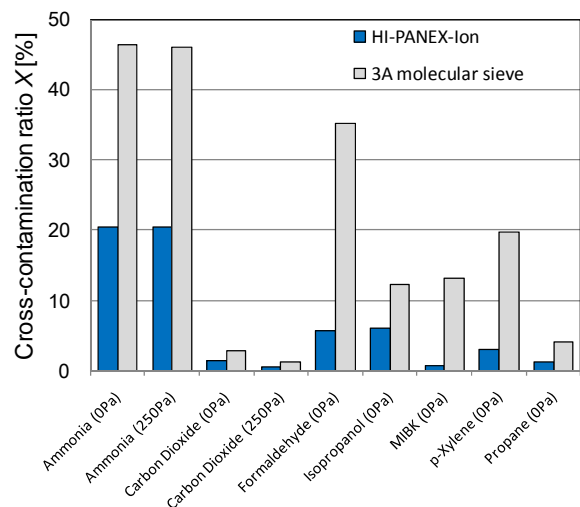


Fig.3 Comparison of the cross-contamination ratio  $X$  between HI-PANEX-Ion and 3A molecular sieve enthalpy wheels.