Project Name:

The 1st Integrated PAU with Desiccant Wheel (D-PAU System) for Wards in Hong Kong Hospitals (Hong Kong Baptist Hospital)

Project Type:

Green Technology on PAU for Energy Efficiency

Member's Role in the Project:

Design, installation and gas supply for the integrated D-PAU system

Completion Month / Year:

Feburary 2020

Contact Information:

Member:

The Hong Kong and China Gas Company Limited

Contact Person:

*Ir Charles Tsoi / Ir Ivan Mo / Ir Sammy Kong*
*Phone: +852 2963 3326 / 2963 3411 / 2963 3368*
*Email: charles.tsoi@towngas.com / ivan.mo@towngas.com / Sammy.kong@towngas.com*

## Project overview

Hong Kong's humid climate causes problems such as mould growth, undermining indoor air quality (IAQ) and leading to issues such as Sick Building Syndrome (SBS). In a bid to enhance customer comfort and combat the COVID-19 pandemic, businesses have taken precautions to improve IAQ and mitigate the transmission of the deadly virus through respiratory droplets. To help its customers achieve this objective, Towngas has been vigorously promoting the use of desiccant dehumidification, which offers precise control on humidity.
The Hong Kong Baptist Hospital places great emphasis on holistic care in which patients' physical and emotional well-being are both cared for. Noting the importance of IAQ control, the hospital would like to renovate their primary air-handling unit (PAU) on rooftop, equipping with humidity control and space heating functions. However, based on the site survey, the existing rooftop is already fully packed with outdoor equipment. Difficulty is encountered in finding enough space for the installation of an additional gas desiccant dehumidifier with related ductworks and accessories.
By integrating the desiccant wheel into the PAU and applying several gas water heaters for the regeneration process, potential of cross-contamination between flue gas exhaust and dry processed air can be eliminated. The all-in-one design also eliminates the need for a stand-alone dehumidifier and the associated air-ducting, thereby significantly economizing installation space and equipment investment.

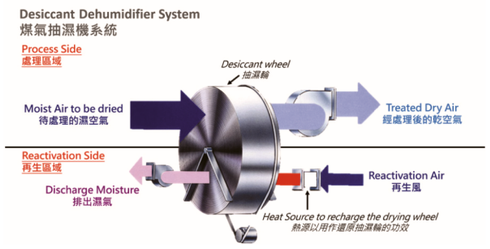
## Fulfillment of Assessment Criteria

### Humidity Control for Pandemic Concern:

High humidity not only weakens patients' health, but also causes critical medical equipment to deteriorate. Moisture condensed on surfaces leads to corrosion or micro-corrosion of equipment, resulting in inaccurate readings in sensitive devices.
As part of Hong Kong Baptist Hospital's ongoing developments in services and technology, it collaborated with Towngas to renovate one of its Primary Air Handling Unit (PAU) on rooftop, with precise control of supply air at 22°C with 60% relative humidity at the nurse station and ward area on the seventh floor to provide a comfortable and hygienic environment for patients.

### Introduction of Energy Efficient Dehumidification Method:

Dehumidification is an energy-intensive process. The conventional system relies on chiller system for humidity control, and thus cannot adjust the humidity without lowering the indoor temperature, resulting in electricity usage being jacked up and relevant carbon dioxide emissions.
On the other hand, the desiccant dehumidification system removes moisture directly to reach the desired condition. This process, if optimized, can lower the cooling load and dry the air to any desired humidity level.
Normally, a standalone desiccant dehumidifier is used in the ventilating system, which consists of a titanium silica gel-based honeycomb desiccant wheel, a processing stream and a reactivation stream. The desiccant wheel rotates at about eight to ten revolutions per hour between the two streams. On the process side, air is drawn through the desiccant wheel where moisture is absorbed by the desiccant. At the same time, the moist wheel sector turns to the reactivation side where a hot air stream drives off the moisture.




In the case of Hong Kong Baptist Hospital, as the existing rooftop is already fully packed with equipment, difficulty is encountered for finding enough space for installing the additional gas desiccant dehumidifier system with related ductworks and accessories.

### The 1st Integrated D-PAU for Wards in Hong Kong Hospitals:

In view of this, Towngas introduced the Integrated Primary Air Handling Unit with Desiccant Wheel System (Integrated D-PAU System). Instead of having a system with a standalone gas desiccant dehumidifier and a PAU, the desiccant wheel is integrated into the PAU, thereby significantly reducing the space needed. By applying several gas water heaters instead of a gas direct-fired one to the regeneration process, this method mitigates the fire hazard of mixing exhausted flue gas with dry processed air. On top of that, an additional hot water circuit with heat exchanger is also equipped in the PAU so that the supply air could be warmed and space heating function could be provided.

### Smart Technology:

Instead of requiring the installation of additional standalone control panel traditionally, an interactive touchable smart control panel is embedded in the body of integrated D-PAU. The smart control panel is compactly built compared with traditional control panel. With less relays and cables, chance of malfunction is minimized and the reliability of the system is further enhanced.
With the built-in touch screen display, real time condition can be monitored at a glance. The user-friendly touch screen display also allows the users to change the setting to desired supply condition. With its internal storage, data such as supply air conditions, outdoor air conditions, supply airflow and running hours can be stored and retrieved for energy analysis. With the capability of Internet of Things (IoT) extension, users can acquire the status and real time condition of the integrated D-PAU anytime anywhere.

### Benefits to Stakeholders:

**Integration with renewable energy for energy saving**

Desiccant dehumidification lowers the cooling load and yields less energy consumption than conventional HVAC system, bringing about a 22% saving in carbon emission. The utilization of renewable energy can bring further saving in annual energy use.
The integrated D-PAU provides the option of combining a solar collector system with gas water heaters for significant heating in the regeneration of the desiccant. By utilizing the renewable energy, the system brings an additional 5% saving in energy.

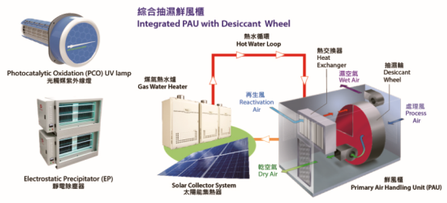
**Operation cost savings for Hong Kong Baptist Hospital**

With the integrated D-PAU now available, the wards no longer rely on the chiller system for humidity control. Thus, the burden on the PAU and the cost of running the heating, ventilation and air-conditioning system is greatly reduced by 18%.

Meanwhile, maintaining high-quality indoor air not only improves the comfort level of the wards, but also suppresses microbe growth through effective humidity control, thus providing a comfortable and hygienic environment for patients. By providing space heating function, the wards are kept warm. In turn, this reduces the demand for clothes and linen, which further brings about savings in laundry and other operational costs for the hospital.

**Raising the standard of fresh air treatment for complex buildings**

With the manifest environmental performance with economic benefits, the integrated D-PAU is the first of its kind to provide medical-grade treated fresh air, and has gradually been applied in hotels and shopping complexes. The integrated D-PAU is flexible in that it can be equipped with different components based on client's needs.
Also, in response to the pandemic, research is currently under way for the installation of Electrostatic Precipitator (EP) and Photocatalytic Oxidation (PCO) UV lamp at the off coil position of the PAU. EP can filter fine particles, and PCO can generate 254nm UV-C to inactivate and remove pathogens within the HVAC air stream. UV-C has been recommended by many different entities including ASHRAE and the CDC. Scientific publications even reported that a "very small dose" of 254nm UV-C was enough to achieve full inactivation of the SARS-CoV-2 virus. All these additional components help to the ever-rising hygiene standards for fresh air treatment.




## Conclusion:

The integrated D-PAU does not rely on chiller systems to regulate humidity. Thus, it reduces the burden on the PAU and chiller system, while cutting down HVAC running costs for the hospital. Meanwhile, maintaining high-quality indoor air not only improves the comfort level of staffs and patients, but also suppresses bacteria growth, thus offering a comfortable and hygienic environment to help prevent the spread of pathogens.