

Towards high-performance and more sustainable industrial dehumidification



I. Dehumidification: a critical need for industry

The food, pharmaceutical and electronics industries are forced to deal with a major challenge: moisture management in their production environments. In cold meat and fish processing workshops, or in pharmaceutical laboratories, excess humidity leads to condensation, frost formation and the risk of bacterial contamination. Until now, technological responses have sometimes involved considerable energy consumption. But this observation will change.

II. Current solutions have changed little and are energy-intensive

For a long time, dehumidification has been based on Air Handling Units (AHUs) in which cooling and reheating take place. However, it is difficult to achieve very low humidity levels when the dew temperature becomes negative and the equipment freezes. In this case, equipment based on desiccant wheel technology is preferred; The air circulates through a wheel covered with a desiccant material, which, in order to maintain its adsorption power, must be constantly regenerated at high temperatures (Fig. 1). Not only does it heat up the air blown, but the energy bill soars!

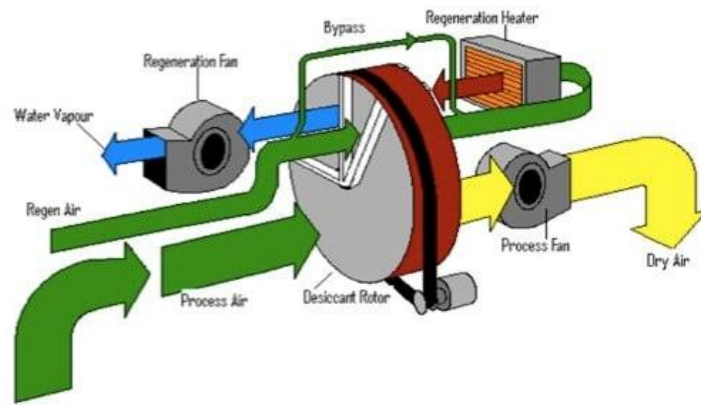


Figure 1. Schematic diagram of a desiccant wheel

Energy consumption depends on many factors: the desired humidity level, the temperature of the air to be treated, the volume of air to be treated, etc. For industrial facilities, electricity bills rise rapidly and impact production costs. In a context where energy sobriety and carbon footprint are becoming priorities, a new offer is needed.

III. For energy-efficient dehumidification, new technology is now available

As the issue is recognized by government agencies and significant for many manufacturers, research efforts have been undertaken by the Mines Paris PSL laboratory. And it is now its spin-off STEM that is making their success a reality by offering a solution that changes our perceptions of the energy consumption of industrial dehumidification.

Now commercially available, the NEODRY® solution uses a patented principle based on the use of membranes permeable to water vapour on either side of which a saline solution (CaCl_2 concentrated in water) is sprayed (Fig. 2).

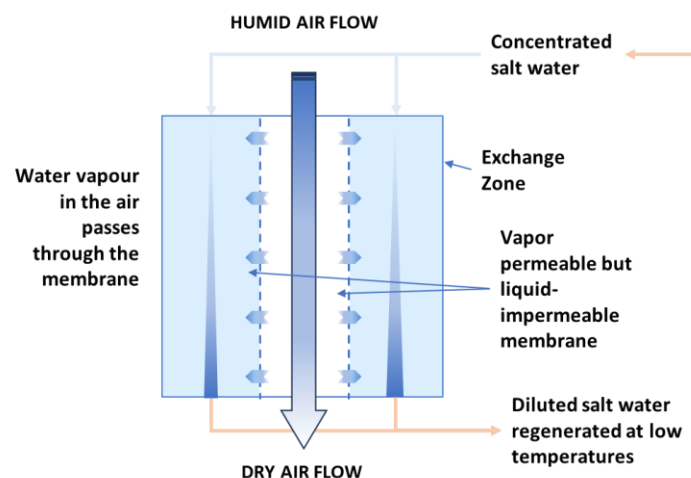


Figure 2. Patented principle of the NEODRY® solution

Water vapour from the air migrates through the membranes by being captured by the salt in the water circulating behind the membranes. Without the need for excessive cooling or a high regeneration temperature, dehumidification is made ultra-efficient, with energy consumption divided by 2 to 4 compared to traditional solutions.

IV. Simple and efficient industrial integration

Already proven in an industrial environment (for more than a year, on an ice cream manufacturing site), NEODRY® is deployed in the form of a modular system comprising three sub-assemblies (Fig. 3):

- **The dehumidification module** : The air to be treated passes through a set of membrane exchange cells where the moisture is captured by the saline solution which is diluted. The supply air is dehumidified and fully complies with the temperature and humidity regulations required by the site.
- **The regeneration module** : The saline solution is maintained at its optimal concentration thanks to a second set of membrane cells that works on the opposite principle. Dry outside air captures water vapour from the saline solution heated to a very low temperature. The saline solution is thus regenerated, returning to its optimal concentration.
- **The fluid management and supervision module** : It ensures the dynamic control of the circulation of saline solution, optimizing temperatures and flow rates to guarantee maximum performance and control the perfect achievement of the setpoints.

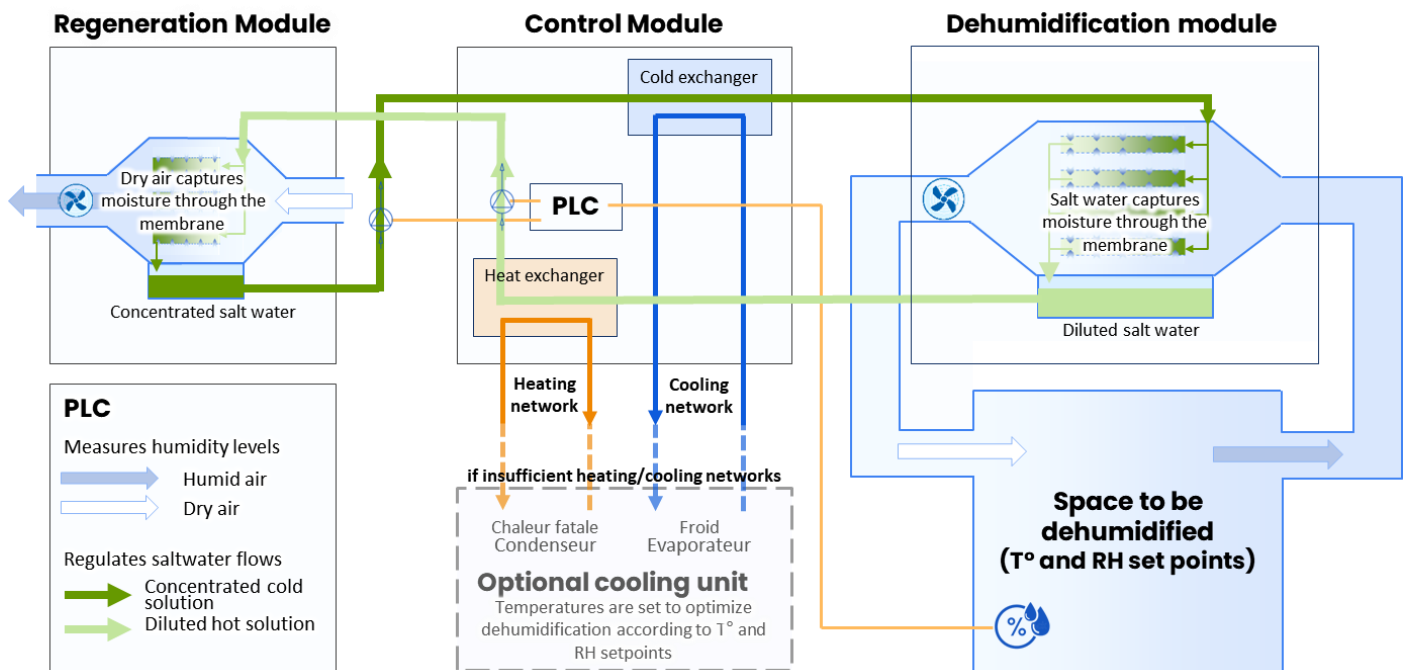


Figure 3. Implementation diagram of the NEODRY® solution

The NEODRY® solution meets the priority needs of manufacturers:

- It dehumidifies the air in a room precisely at a constant temperature in outdoor conditions between -15°C and +40°C
- It can reach a very low absolute humidity level (up to 1 g/Kg - dry air) at any room set temperature
- It makes dehumidification possible at sub-zero dew temperatures without doubling the number of systems for continuous operation

- Simultaneous cooling of dehumidified air is made possible without regenerative overconsumption

The size may be larger than a one-piece desiccant wheel system, but it provides more flexibility: the regeneration module can be placed outside the room to be dehumidified, which simplifies ventilation.

V. Energy consumption reduced by up to 75%

Energy optimization is at the heart of this innovation. In contrast to desiccant wheels which require regeneration temperatures of around 100°C, NEODRY® uses moderate heat (30 to 40°C), which can be easily recovered via existing sources such as a refrigeration unit (sometimes added if necessary), an existing heating network, or an unexploited waste heat deposit (Fig. 4).

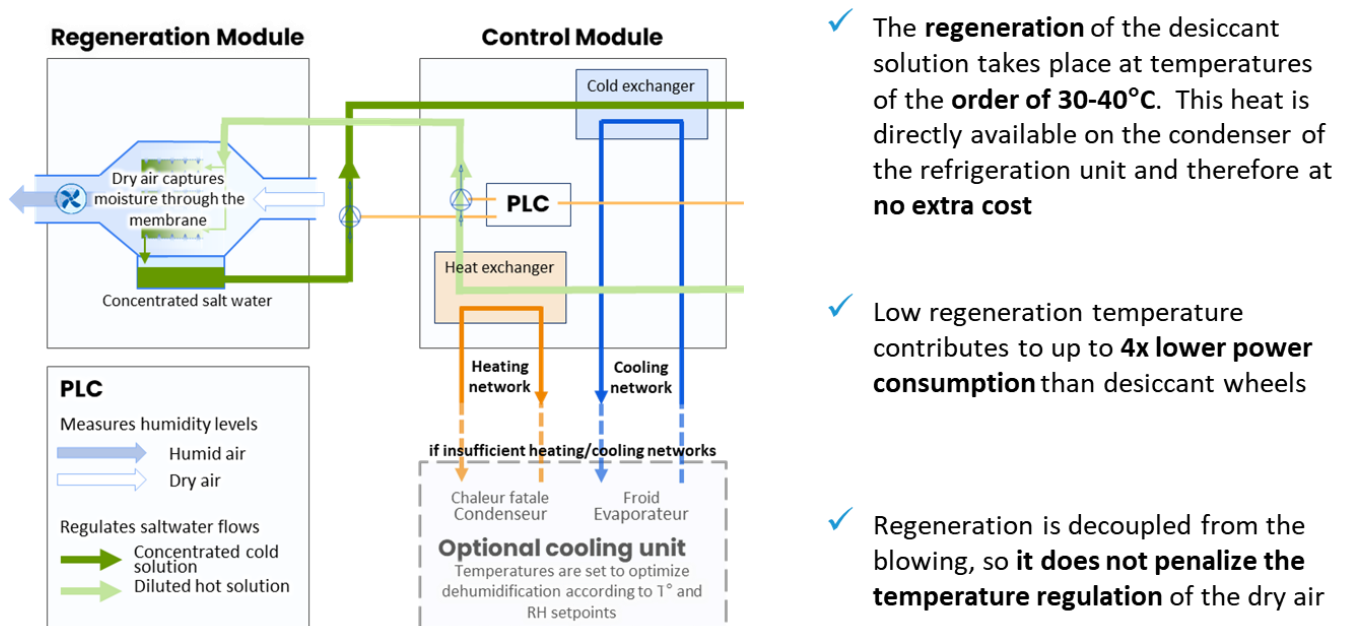


Figure 4. Energy savings on regeneration

Another key point : the tangential passage of air, along the membranes forming the exchange cells, generates much less pressure drop. This significantly reduces the power required for ventilation (Fig. 5).

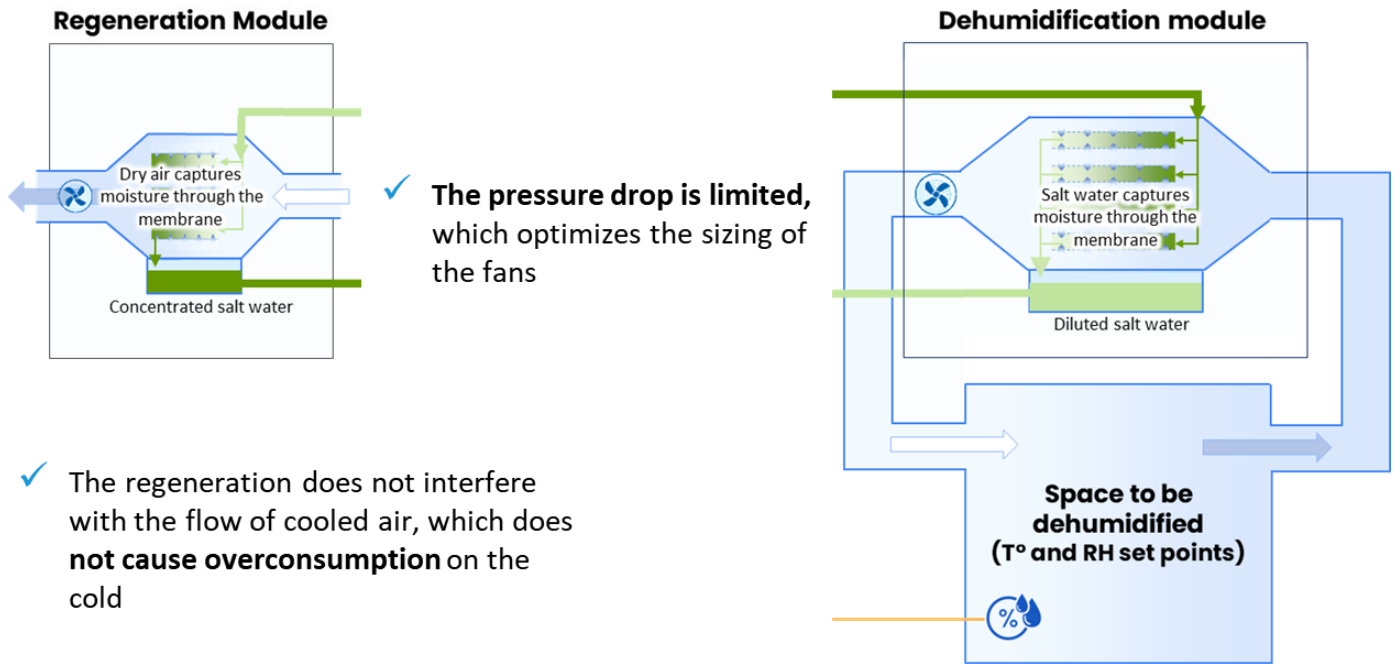


Figure 5. Energy savings on ventilation

Finally, a decisive advantage: with this solution, it is also possible to lower and control the temperature of the air to be treated. This can be done by lowering the temperature of the salt solution sprayed into the dehumidification module. This relieves the existing cooling systems at a lower cost (Fig. 6).

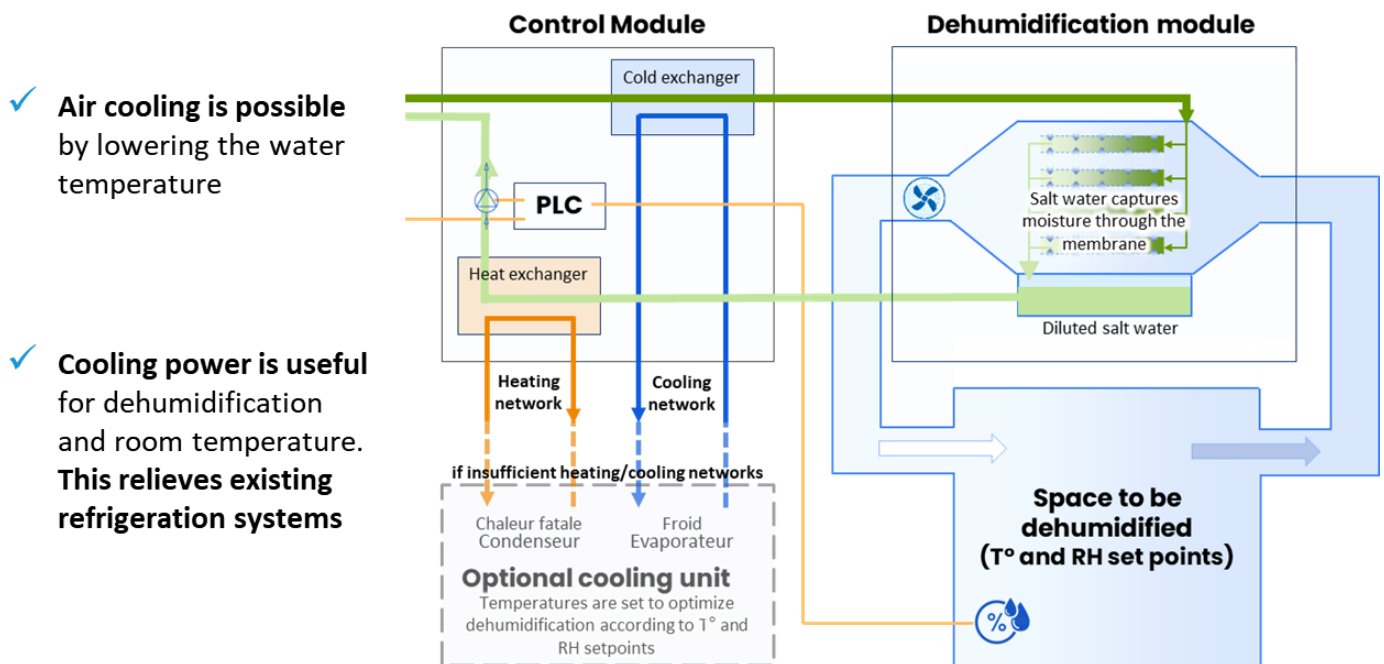


Figure 6. Energy savings on refrigeration production

VI. Validation: results and measurements

An ice cream manufacturing site tested NEODRY® for 1 year with very significant results:

Operating conditions:

- Temperature maintained at 15°C
- Relative humidity stabilized at 60% (6.3 g/kg)

- Treated air flow: 5,000 m³/h

Selected location and operating parameters:

- 3 STEM modules and a refrigeration unit (Fig. 7)

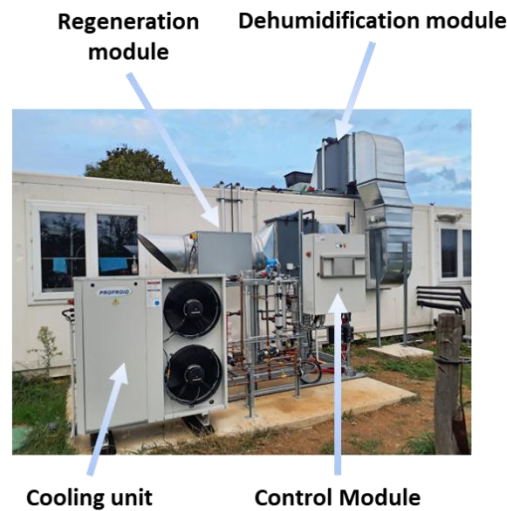


Figure 7. Implementation of the NEODRY® pilot unit

- Cold solution temperature: -3°C (supplied by the cooling unit)
- Hot solution temperature: 35°C (heat recovery from the refrigeration unit condenser)

Measured consumption:

- NEODRY®: 6.5 MWh/year
- Traditional solution (AHU with cooling/heating): 16 MWh/year
- **Savings: -60% in energy consumption!**

The financial impact is significant: for a large industrial site, the annual savings amount to tens of thousands of euros, easily justifying the initial investment.

In addition to the proven reduction in energy bills, this pilot unit has validated the industrial feasibility and key performances:

- Accurate and consistent maintenance of set instructions
- Minimized return to instructions after humidity peaks induced by the very frequent washing operations on this type of site

VII. Innovation for a more sustainable industry

In addition to energy savings, this technology offers manufacturers an opportunity to reduce their carbon footprint and adopt a sustainable approach. By actively contributing to energy sobriety, it facilitates the achievement of decarbonization objectives and strengthens their strategy in the face of future energy challenges.

With NEODRY®, STEM brings a new, more sober and smarter approach to moisture management. In an increasingly demanding regulatory and economic context, this innovation represents a real opportunity towards more responsible practices with savings prospects that allow you to consider investing with peace of mind.