

THE ENVIRONMENT, THE ENERGY SAVING AND THE SAFETY OF SECONDARY REFRIGERANTS

Sustainable Development constitutes from now on a true stake of responsibility in the field of refrigeration systems and contributes to indirect cold” techniques with secondary monophasic and diphasic refrigerants, to the safeguarding of the environment, to energy saving, and to the safety of secondary refrigerants.

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Refrigeration plants with “ indirect systems” present two major points from the point of view of environment safeguarding and particularly of the greenhouse effect , they are:

- Considerable reduction in refrigerant charges and therefore elimination of refrigerant losses.
- Energy consumption saving in ” indirect refrigeration” plants

Refrigeration plants with secondary refrigerant systems concern particularly:

- installations higher than 50 KW
- installations of distribution with multiple stations and important distances
- installations with high variations of refrigeration need

for example:

- supermarkets and hypermarkets
- agro-alimentary installations, slaughter-houses, dairies, cold stores, etc
- refrigeration plants of all kinds having high variation needs

Considerable reduction in high refrigerant charges and practically elimination of refrigerant losses.

Thanks to indirect refrigeration plants it possible to **distinguish** clearly the **production of cold** from the **transportation of cold**.

The production of cold makes it possible to carry out Compact Units built inside factories:

- Refrigerants in the Compact Units are confined in short pipings and therefore the charge of refrigerant is very low.
- Compact units are built inside factories, therefore the products and the welding of the

pipings are of high quality.

- The circuit of the transport of cold does not contain a refrigerant but only a secondary refrigerant.

In short, Refrigeration plants with indirect systems contain only low charges of refrigerant and it is, therefore, possible to eliminate refrigerant losses.

Energy consumption saving in indirect refrigeration plants.

The energy consumption of power for a direct system is thermodynamically better because there is one stage of temperature, whereas an indirect system has two stages of temperature.

However a comparison between energy consumption and system producing direct cold and a system producing indirect cold must take into account the design of the whole refrigerating system i.e.:

- production of cold
- transportation of cold
- end user.

Cold Production

In indirect systems the cooling of the secondary refrigerant requires an additional temperature of evaporation because of the two stages of temperature

However if one compares:

a direct system of a Compact Unit with a direct system including the distribution system it is necessary to take into account:

- the very long piping which requires speed with the return of the oil
- the regulation of expansion valves and their pumping
- the overheating temperature
- the regulation because a very weak inertia leads to frequent stops and starts-up of several compressors

Whereas the result should be favourable to direct systems finally we can see that the level of evaporation temperature for an indirect system is on the same level of temperature as the direct system.

The practise shows, that an installation including a direct circuit of distribution, and an indirect system the temperature of evaporation and thus the refrigerating output of both systems are identical

Distribution or transportation of cold

- The advantage of **storage of cold energy** in the case of indirect systems and secondary refrigerants

(monophasic but even more in the case of diphasic secondary refrigerants) makes it possible **to store energy during the night** with condensation temperatures much lower since in the case of a condenser by air the difference in temperature can be from about **10°C to 15° C in summer** between days and **nights**, which leads to a relatively important energy saving.

- We know that the maximum of energy last only a few days per annum and leads us to oversize the installations from 20% to 30%.

Unlike installations with a distribution of direct cold, the storage of energy in a system of distribution of indirect cold makes it possible to spread out energy and to dimension the refrigeration plant for an operation which does not take into account the maximum of energy.

This advantage allows the installation to use less refrigerating and electric material (20% to 30%.less).

The advantage of the storage of cooling energy makes it possible to reduce the quantity of energy even by taking into account the complementary energy needed for the secondary refrigerant transport by the pump.

End-user

- A refrigeration plant requires defrosting of the evaporators .Consumption of energy is considerable especially when the defrosting is of the electric type.
- The advantage of an indirect system makes it possible to work at higher temperatures of secondary refrigerant in the evaporators than the temperatures of a direct expansion system.
The formation of white frost is therefore less important, less hard, and thus easier to eliminate.

There are Various methods that enable to defrost the evaporators with the secondary refrigerant itself, these methods lead to substantial energy saving.

In conclusion Indirect Systems with secondary refrigerants contribute to:

- **the safeguarding of the environment**
- **energy saving**
- **the safety of secondary refrigerants**

Even if they have been used for a long time, indirect system plants with secondary monophasic refrigerants have to be updated in order to face the problems of the environment

A new technique of secondary diphasic refrigerants called “ice slurries” reinforces considerably the advantages of secondary monophasic refrigerants.

Let us point out the most important points briefly:

- Use of latent heat of secondary refrigerants
- Cooling capacity 4 to 5 times higher

- possibilities of storage of energy 4 to 5 times higher
- smaller tube diameters for the piping systems
- lower energy demand for the pump

Diphasic secondary refrigerants or ICE SLURRIES

- **Strengthen considerably the advantages of conventional monophasic secondary refrigerants .**
- **Eliminate the disadvantages from monophasic secondary refrigerants.**

Certain generators of ice slurries are now ready to be used.

Applications have left the laboratories and the installations are now operational.

Among the most advanced countries in this field there are: Canada, Europe (Germany, Switzerland, France,) and Japan.

The advantages offered by “indirect systems of ice slurries ” are indisputable and yet the number of industrial facilities are developing very slowly.

This process is probably being hindered because of: :

- Fear of innovation
- High initial price
- The diffusion of this technique

We encourage engineers and Refrigeration Companies to go ahead in ICE SLURRY SYSTEMS for a Sustainable Development.

I thank I I F/I I R which contributed very much to the development of “ice slurries”

(since the first Workshop on Ice Slurries in Yverdon in Switzerland in 1999 with President P.W. Egolf since the 7th Congress in 2006 in DINAN), and also Mr BUONI of

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