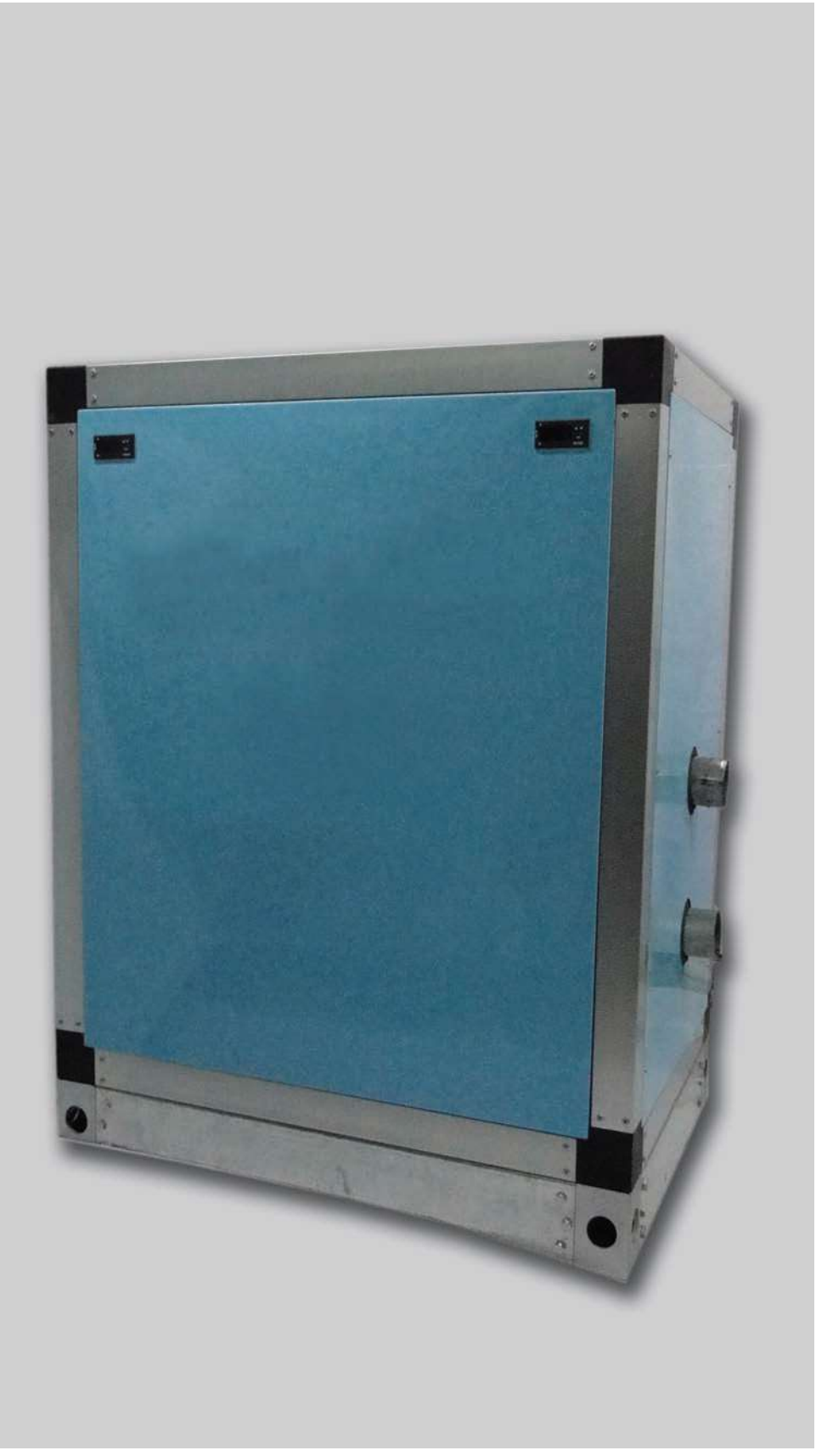

Low Energy Heat Pump Air Dryer

How to maximise output of dry pre-heated air from a heat pump with minimum energy input.

Then & Now

Then

- Refrigeration equipment was mostly imported and heavily taxed, thus expensive.
- Space, energy, water and overhead costs were low.
- Low installed cost was the prime consideration.

So direct heating of fresh air by fuel, steam, or electricity was normal.

Now

- Taxes are low and so are costs of both imported and local equipment.
- Space, energy, water and overhead costs are high.
- Low energy, space & water use and low life cycle cost are the ruling criteria today.

So the heat pump is now a more logical choice for drying.

Why Heat Pump?

One kilowatt input into a Heat Pump puts almost four kilowatts of heat into the air.

How is Low Energy Heat Pump Better?

Since the evaporator also removes moisture from the air, the low energy dryer uses the evaporator as a front end, so that the leaving air has a much lower moisture content.

Thus it can remove more moisture at any given temperature than heated ambient air.

How Does that Help?

More people can get into a train compartment if it is empty.

More moisture can be absorbed by air at the same temperature, if it is drier.

Does not it Reduce the Heat Output?

No because a reflux loop removes sensible heat from the air before it enters the evaporator and adds it back afterwards.

The evaporator then has to carry mostly the latent load. So it removes more moisture from air for the same energy input, thus also recovering more heat.

The higher amount of recovered

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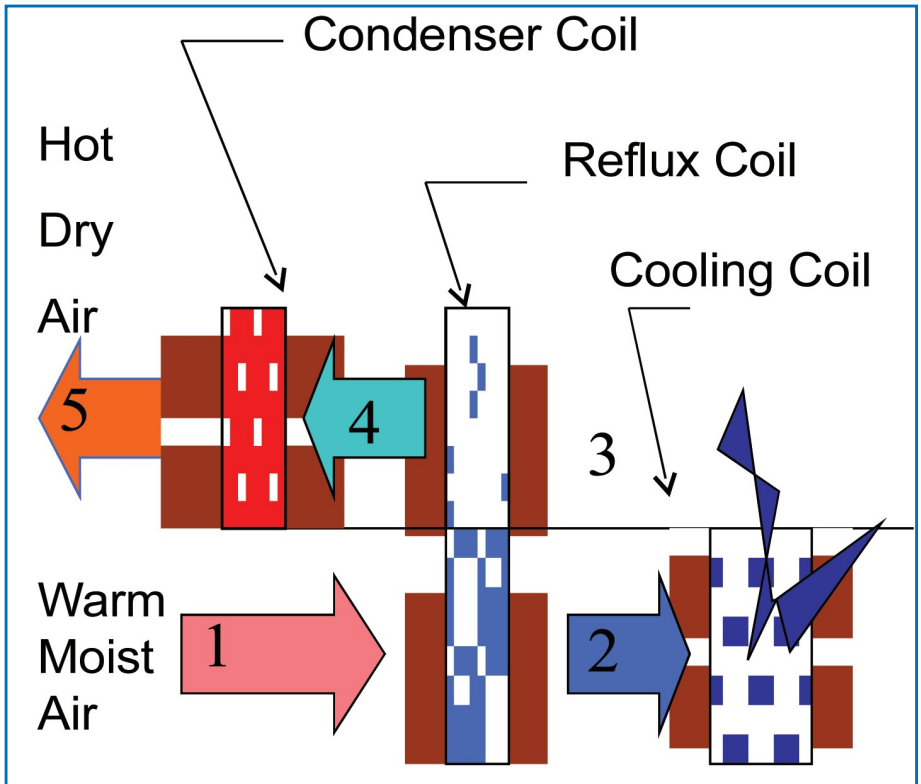
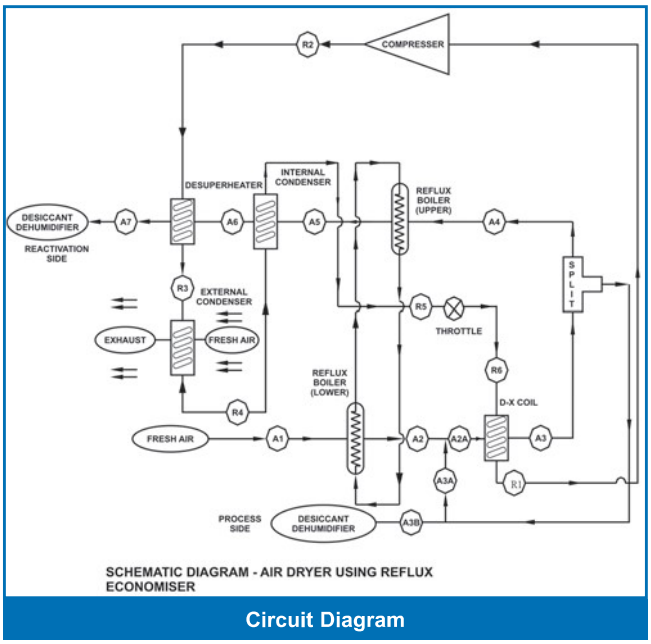
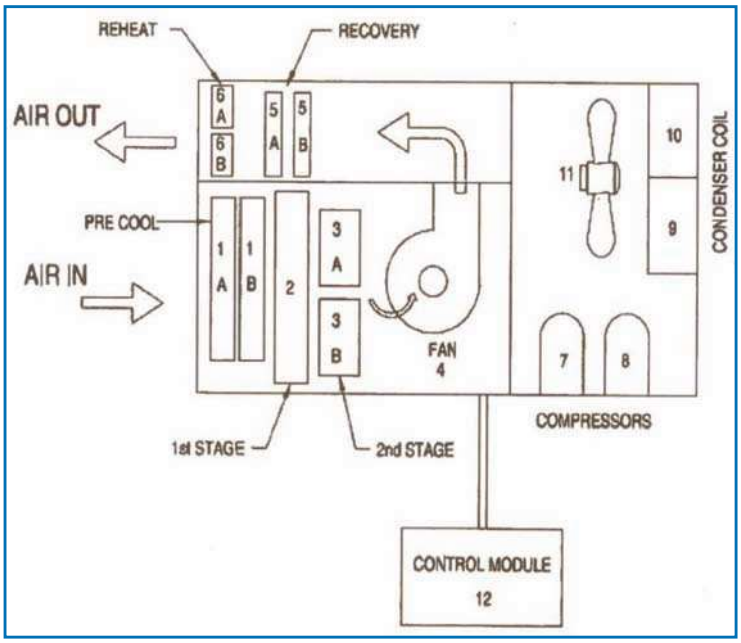


How Reflux Boiling Improves Heat Pump Efficiency

Surendra H Shah, Mechanical Engineer from Clemson University, USA, has major HVAC projects to his credit: Air India Terminal, SBI Building, Oberoi Towers, MSEB Prakashgad Mumbai, SriLanka Oberoi, a housing complex at Baghdad Iraq. He started Pan Asia Corporation, a breeding ground for his many innovative energy saving products, some of which are patented now. He designed wind towers for CII-Sohrabji Godrej Green Building Center in Hyderabad, that received country's first Platinum rated LEEDS building. He combines the techniques used in cooling of heritage structures such as the Taj Mahal with modern technology. It needs only 150 watts to extract three tons of solar heat load. In an air conditioned pharma warehouse it has reduced its cooling load from 57 tons to 24 tons. The Mumbai University Institute of Chemical Technology recognized him for heat pump air dryer that has a C.O.P. of 6.7 made for their lab. His inventions are: An AC with EER of over 15, a packaged AC with its own integral ice thermal storage. He has won a BRY-AIR award and U.S. Patent for it. He is a life member ISHRAE, IIID and SESI. He is also a visiting faculty at Rachana ansad's Institute of Environmental Architecture.



Circuit Diagram



heat is also added to the output air.

So we get a larger quantity of much drier hot air. In an ordinary heat pump, the reflux coil is absent.

Air has to be cooled to its dew point before condensation starts.

This wastes about half the refrigeration capacity thus reduces output.The reflux coil removes sensible heat from entering air, cooling it nearly to its dew point.

So the cooling coil can use its full capacity mostly to absorb the latent load only.

The moisture removal is now almost double for the same energy.

Using with a Desiccant Dryer

The Low Energy Heat Pump is even more effective if it is used as a feeder for a desiccant dryer for very dry air.

It provides much drier and cooler air to the process side than a chilled water coil, thus reducing the load on the desiccant wheel.

It also provides dry hot air to the recharging section, increasing its capacity & reducing the heater energy requirement. The result is a smaller desiccant unit and lower energy consumption.

Coefficient of Performance

The heating C.O.P. of the UICT unit was determined be 3.0 and the cooling C.O.P. was calculated to be 3.7.

Since the Low Energy Heat Pump provides both the functions together, the overall C.O. P. would be 6.7.

This is higher than any heat pump commercially available today.

A second Stage

- A limitation of the sigle stage design is that dew point of the leaving air has to be kept above zero degree C. in order to freezing of condensate in the evaporator.
- By adding a second stage of a similar design, it is possible to produce at a dew point below zero degree C.
- This circuit is specially designed to avoid interruption by a defrost cycle.
- Both open & closed loop operation is possible.

Advantages

Its unique design uses only DX refrigeration for both dehydrating and re-heating the air or even inert gas.

Its combined air dehydration plus product drying C.O.P., is about 10.

This means that every watt of energy will produce ten watts worth of drying, There is no need for desiccants, brine, steam, hot water or electric heaters, though supplementary heaters could be added if, in a rare case, higher temperatures are desired.

This invention is covered by U. S. patent No. 8365542. Patents in India and EU are pending.

Applications

To produce and maintain low humidity at low temperature, say 20% @ 2^0C in critical applications such as Pharma units.

To dry aqueous coatings on tablets of heat sensitive medicines.

To dehydrate foods and agro products at room temperature and pressure for preserving their color, taste, aroma etc.

As a heat pump source for dry hot air.

Conclusion

None can stop an idea whose time has come. The time of heat pump driers has come. This design could be your key – or your competitor's. ■