

# Sky powered refrigeration

The opposite of solar heating is stellar chilling? asks S.Ananthanarayanan.

Cloudless nights in places where the air is dry can become quite cold even in midsummer. This is a feature that can help chill water for use during the day.

## Heating and cooling

The temperature of empty space is an eerie fraction of a degree above absolute zero. While, in the normal course, planets would get unbearably hot on the side that faces the sun, the opposite side would chill to nearly the temperature of empty space seconds after sunset. The reason this does not happen on the earth is that we are protected by a thick blanket of air, in the form of the atmosphere. The air softens direct sunlight and during the night, the atmosphere insulates us from the freezing exterior and keeps us reasonably warm.

But on the moon, which has negligible atmosphere, the days *are* scorching and the nights freezing.

## Moist and dry places

The effect of the atmosphere is not the same at all places but depends on how much water content there is. The air is more effective as an insulator when it is moist. This is because the water molecule has a heavy oxygen atom and hydrogen atoms as 'wings', and the molecule can store more energy when it spins. Water content of the air then uses up the sun's energy before it strikes the ground and also stores the energy after the sun has set. But in dry places, like in deserts, the air has little moisture and the day does get burning hot while the night gets cool like in winter. Typically, the temperature keeps falling throughout the night, till the coldest moment, a few minutes *after* sunrise.

## Water cooling system

Mr Whelpdale, an imaginative engineer in the railway workshop at Ajmer, Rajasthan, used this feature to provide 12,000 workers with cool drinking water during the hot days. His arrangement used 'atmospheric cooling and had no moving parts and consumed no electricity. The setup was just a large, insulated water tank, placed at ground level, with connections to a mesh of pipes that acted as a heat exchanger, placed on the roof of the workshop. The fact that warm water is lighter than cool water kept moving the water from the tank to the rooftop heat exchanger. The water that got cooled then sank down to the tank, to make way for more warm water to rise and get cooled, throughout the night.

The result was a convection current that lasted all night and by morning, the water tank was full of water cooled down to 10°C, like in a proper refrigerator. The insulation around the tank kept the water cool during the day and a valve isolated the cool water from the open pipe on the roof. The cool water was run through insulated pipes to different parts of the workshop, for workers to drink. And after sunset the valve was opened and tank filled right up to the rooftop exchanger, to start off the cooling cycle during the night.

### **Green times**

This was all thirty years ago when electric water coolers were a rarity. Even for ambient cooling, there were no electric desert coolers and the norm was moist grass curtains. Every want was met, without the din of electric motors and the noise and pollution of DG sets, which we get when the power fails

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