Revolution in Cooling Technology

Cooling by the evaporation of water occurs throughout Nature, and belongs to the oldest known technologies used by Mankind. The principle could not be more simple: The process of evaporation removes heat from the surrounding medium, producing a corresponding cooling effect.

Now, a breakthrough in the physics of nonlinear vibrations promises to revolutionize the applications of this old principle. Thanks to an original invention by the physicist Danil Doubochinski, it is now possible, using very small amounts of energy, to accelerate the natural process of evaporation of water by millions of times. The result is an intense cooling source with a wide range of potential applications. In the field of air conditioning of rooms and buildings, the new method offers enormous savings in energy and equipment costs compared to conventional compressor-based refrigeration technologies, while at the same time eliminating the production of large amounts of waste heat, associated with conventional methods. The new technology also opens up the possibility of replacing the giant cooling towers of power stations and industrial plants, by much smaller and more economical units. The world-wide market potential for the new process lies in the multi-billion-dollar range.

Background:

Adiabatic cooling systems based on the evaporation of water, are widely used today. They range from "wet" cooling towers for power stations, to small evaporative room coolers (sometimes called "swamp coolers") for domestic use. But present-day evaporative cooling technology has substantial drawbacks and limitations. In moderate temperatures the evaporation of water is a slow process. Achieving substantial cooling effects requires large surfaces for evaporation and large air flows. In the case of industrial cooling, for example, this leads to large, costly structures (cooling towers), and significant energy requirements for pumps, air circulators etc. In addition, bacteria can multiply in cooling towers and on the wet matrices and filters of evaporative coolers, creating potential health hazards.

The atomization of water into fine droplets, provides an alternative method for increasing the effective surface-area for evaporation. Unfortunately, the optimal droplet sizes of less than 1 micron diameter, are difficult and costly to achieve using conventional atomization methods (high-pressure nozzles and ultrasonic devices). Finally, the performance of existing evaporative cooling systems depends strongly on atmospheric conditions. Under conditions of high atmospheric humidity, the cooling effect is greatly reduced, and unstable conditions can arise in large-scale installations.

Breakthrough:

Decades-long research and development work by the Russian-born physicist Danil Doubochinski have led to a revolutionary new technology, which vastly increases the effectiveness of adiabatic cooling, overcoming many of its limitations and drawbacks. In Doubochinski's novel "cooling reactor", pulsating flows of air and water, whose pulsation frequencies differ by a factor of ten or more, are made to interact with each other in a highly nonlinear fashion, generating a complex spectrum of additional frequencies. This, in turn, leads to a phenomenon called "multiresonant cavitation" and to a cascade-like process of break-up of the water into droplets whose average diameters are much less than 1 micron. Under conditions of intensive thermal transfer with the surrounding medium, a portion of the water evaporates instantly, producing a sharp drop in temperature in the air-water mixture. Depending on the starting temperature, temperature drops of 40 degrees C or more can be achieved between the inlet and outlet of Doubochinski's cooling reactor. The energy requirements of the process are a tiny fraction of the achieved cooling power. The design of the cooling reactor can be adapted and optimized according to the particular application -- whether for the cooling of water (for example, for power plants and industrial facilities) or for the cooling of air (air conditioning). The performance of the cooling reactor is extremely stable and does not depend strongly on atmospheric conditions.

The efficacy of Doubochinski's cooling reactor can be demonstrated at any time, using a portable prototype device created for that purpose.

Current State of Development:

The international patent rights for the new cooling method (European Union 1216061, USA 10/149.696, Australia 28544/01) belong to the inventor and developer of the process, Danil Doubochinski. Doubochinski, now a French citizen, is an international expert on nonlinear oscillations and author and coauthor of numerous technical publications and patents, going back to ground-breaking original discoveries made by him in the Soviet Union in the 1960s and 1970s.

A peculiarity of the Doubochinski atomizing and cooling method, is that the theoretical analysis of the process is extremely complicated, while the cooling reactor itself is technically relatively simple to construct. Nevertheless, considerable know-how is involved in the control and application of the process, in the choice of frequencies and the design and optimization of the cooling reactor.

The basic technology of the Doubochinski cooling reactor has been refined and extensively tested in recent years, in the context of realization of experimental prototypes for industrial cooling and other applications of the multiresonant atomization process. Performance and operating parameters of prototype systems have been measured and certified by Bureau VERITAS as well as the French industrial laboratory LAMI/ENPC-LCPC. The relevant data and data analyses are available on request.

Application studies, carried out during 2006-2009 on contract from the companies AREVA and ENERTHERM, have confirmed the energy-efficiency, economic advantages and environmentally-friendly character of Doubochinki's technologies.

These analyses show that the Doubochinski method has the potential to achieve a coefficient of performance at least *10 times higher* than that of conventional refrigeration technologíes. (In other words, the Doubochinski system requires 10 times less energy, or even less, to achieve a given cooling effect). However, considerable development and optimization work is needed in order to commercialize the applications of this technology to large-scale industrial cooling, as well as to the air conditioning of rooms and buildings.

Meanwhile, Doubochinski has developed a highly efficient, miniaturized cooling device -- a "personalized cooler" or "desktop air conditioner" -- which produces a gentle stream of pleasantly cooled air for the immediate area around a desk, chair, bed, automobile seat or similar location. This product is practically ready for commercialization. Suitable industrial partners are now being sought, for the creation of production-ready prototypes, and for subsequent manufacture and marketing activities.

Finally it should be noted that the basic technological principle behind Doubochinski's cooling method, has an enormous number other potential applications, in addition to those described above. A vast and fruitful field for research and development is opening up, having very substantial commercial and economic implications.