PTC-03
INTERNATIONAL SHORT COURSE ON
PASSIVE THERMAL CONTROL

22-24 October 2003
Antalya, Turkey

PASSIVE THERMAL CONTROL IN REFRIGERATION AND COOLING

Boris KOSOY

An introduction to the basics of passive thermal control in refrigeration and cooling and the basic concepts and issues associated with PTC will be reviewed in the present lecture.

Through centuries man has always made use of a great deal of cleverness to keep cool in hot climates and seasons. He has developed a broad range of passive cooling techniques in various parts of the world up to a very impressive level of maturity: cliff dwellings through the world (ground cooling) wind towers in Iran (convective and mass cooling), sprinkling water with fountains (evaporative cooling), and whitewash (sun protection) in Southern Europe and North Africa. All these cooling techniques were based on careful design in which heat and mass transfer principles did not make use of any mechanical energy to operate: they were totally passive. A big change happened at the turn of the century, when M. Carrier invented the refrigeration chiller. These systems only developed on a large scale after Second World War, starting in the US when mass production brought cost down, and when handy CFCs replaced hazardous ammonia and hydrocarbon refrigerants.

This refrigeration air conditioning and the availability of cheap energy allowed designers to be able to keep objects cool no matter their orientation, insulation level, shading and mass. Thus, in many parts of the world, passive cooling design and techniques were abandoned, until they gained renewed interest in the last couple of decades or so with growth of energy and environment concerns.

However, in spite of their potential, the development of most of passive cooling methods is restricted to some specific parts of the world for a few technologies, while others remain extremely marginal.

The objectives of this lecture are

- to introduce passive thermal control principles in refrigeration and cooling to the participants and highlight its salient points,
- to bring along fundamental physical concepts to solve PTC problems,
- to establish a foundation from which solutions can be developed.

This lecture provides a comprehensive review of heat transfer fundamentals and many suggestions as to the importance of terms and conditions pertinent to the domain PTC application for refrigeration and cooling.

Basic passive cooling strategies and major principles of passive design are discussed with an emphasize on understanding the physics of the problem.