Talk on "The World of Industrial Refrigeration" By Professor Emeritus W.F. (Will) Stoecker, *P.E., Ph.D*

This talk was jointly organised by Building Services Technical Division, IEM and The Malaysia Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (MASHRAE)

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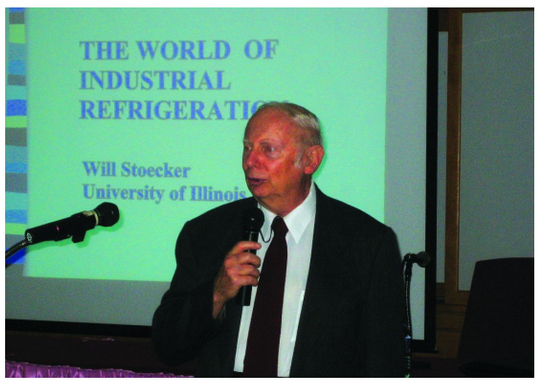
The heating, ventilation, air conditioning and refrigeration industry affects the public's quality of life in many ways, from indoor air quality, to conserving energy in buildings, to the development of refrigerants that do not harm the environment.

As part of its outreach to the engineering community, the Building Services Technical Division of The Institution of Engineers, Malaysia in conjunction with the Malaysian Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, successfully organised a one day seminar on "The World Of Industrial Refrigeration" on Monday, 21 November 2005.

"The World of Industrial Refrigeration" was presented by Professor Emeritus W.F.STOECKER from University of Illinois in Urbana-Champaign, an ASHRAE Distinguished Lecturer. Professor W.F.STOECKER was fresh from a speaking engagement in Hong Kong, Thailand and gave a very interesting and stimulating presentation starting with some historical facts and leading to present day issues. A total of 55 participants attended this interesting seminar.

Prof Stoecker started out by introducing the main applications of industrial refrigeration in food refrigeration and freezing, other important uses can be found in chemical, petrochemical, pharmaceutical, ice and environmental chambers.

Industrial refrigeration differs from air-conditioning as it is characterised by low temperature designs, multistage compression, the need for vessels and different choices of refrigerants. Individual selection of every component in the refrigeration system becomes important as there are many types of compressors, condensers, evaporators, expansion devices available in the market to cater to different system design. Personality of the industry is also somewhat different.



An interesting case in point was for refrigerated buildings, whereby if the space temperature is below 0 deg C, glycol in underground heating pipes beneath the concrete floor has to be incorporated into the design to prevent the soil from freezing.

Multi-stage compression, which operates on a lower compression ratio, will result in better compression efficiency. Flash gas removal and desuperheating are additional considerations when designing multi-stage compression.. The pros and cons of the four main types of compressors were then discussed; e.g. scroll compressors, although bulky, work well on a fixed volume ratio and are favoured for smaller capacities. Reciprocating compressors, very common for industrial refrigeration at one time, are adaptable to upsets and work well under part load. Screw compressors, which became commercially viable in the 60s and 70s, are popular for higher capacities and finally, the centrifugal compressors, which depend on the choice of refrigerant.

Vessels in industrial refrigeration are used for storage of liquid and separation of vapour-liquid. They are used at the high pressure side as high pressure receivers, flash tanks or subcoolers and also on the low pressure side, e.g. surge drums on a flooded coil or thermo-siphon receivers. While expansion devices are common in air-conditioning and moderate refrigeration, liquid level control is often employed instead for industrial refrigeration.

The different choices of refrigerant were then discussed, with particular mention of ammonia as a common choice of industrial refrigerant. Ammonia, with its high specific value and lower density, costs one sixteenth of R507 and has three times the heat transfer coefficient and carrying capacity of R22. Ammonia does no harm to the ozone nor causes any global warming, it has toxicity many times that of R22 but is self-alarming in the event of a leak. Ammonia is immiscible with oil and is not compatible with copper.

Finally, the hybrid cascade system of CO_2 / ammonia was presented, whereby CO_2 is used in the low temperature stage and ammonia in the high temperature stage. CO_2 is one of five natural refrigerants, the others being air, water, ammonia, hydrocarbon. CO_2 has even better heat transfer coefficient than ammonia and will operate at a comfortable pressure even at low temperatures. The advantages of a cascade system are overall improvement in heat transfer and volumetric efficiency, considerable reduction in the ammonia refrigerant charge, lower refrigerant cost as the cost of CO_2 is one tenth cost of ammonia and lower costs of compressor and piping.

A lively Q&A session followed involving many of the participants. Most of the participants have also expressed their views that similar seminars of interest should be conducted more frequently for the benefit of all members. ■