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"Refrigeration Applications with Natural Refrigerants"

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**THE PAST AND THE PRESENT OF
AMMONIA REFRIGERATING SYSTEMS IN
UKRAINE –
WHAT SHOULD BE DONE FOR THE FUTURE?**

by

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THE PAST




Ammonia cooling systems have taken a prevailing place on all industrial and commercial refrigerating plants of Ukraine, since 1945 - 1950 when restoration after World War II and development of a refrigerating industry in the former USSR has begun.

At the beginning of refrigerating plants restoration (basically industrial plants, meat factories, dairies and large trading facilities, or as them called, - distributive cold stores) the compressor's equipment received as reparation from Germany was used. On some plants these compressors had been used up to the beginning of the 80-th.

From the middle of the 60-th, after restoration and development of our own refrigerating industry, in the course of reconstruction and building many new plants and factories, we have started to replace the pre- and after war equipment by refrigerating systems which were manufactured by domestic industry. Thus, because of existing at those times "Iron Curtain", imported ammonia equipment in Ukraine, except very small amount of refrigerating machinery from Czechoslovakia and East Germany (DDR), practically was not used.

THE PAST




The refrigerating industry development specific feature in existing at those times big country – the USSR, was distribution of variously orientated machine-building enterprises involved in refrigerating area among various republics. According to this tendency, Ukraine was specialized to manufacture small and medium freon refrigerating units. Therefore, despite of the large-scale advertising campaign during the 80-th about ammonia installations danger and necessity to switch on freons, in Ukraine the refrigerating industry based on use of ammonia installations continued to develop.

And only in the mid-eighties introduction of decentralized freon cooling systems for fruit and vegetables cold stores has begun. However, in connection with higher cost and complexity of these plants operation in a countryside (leakages of freon because of bad tightness of units, low level of automatic protection and regulation), in Ukraine they were not widespread, and now are mostly in a disabled conditions and the replacements of cooling systems are in great demand.

By the end of the 90-th Ukrainian refrigerating industry (except small commercial equipment) on 98-99 % has been equipped by ammonia cooling systems.

THE PAST



After collapse of the USSR and acquisition of Ukrainian independence, the ammonia refrigerating plants of the country have turned out practically separated from equipment manufacturers, remained mostly in Russia. This fact has seriously complicated our possibility for maintenance and planned repairs with replacement of parts and details, also replacement of worn out equipment to identical new (according to the design decision).

As a result on many refrigeration plants the considerable part of the equipment was disconnected because of full deterioration, and in many cases, cooling systems and even refrigerating enterprises completely stopped to work.

Moreover, because by 1998 the level of agricultural production in Ukraine has fallen up to 50 % of its level in 1990, the needs in refrigerating industry has even more decreased, and in its turn it has led to the further deterioration of storage systems for current and reserve stocks of the foodstuffs.

THE PAST



THE PAST



THE PAST



THE PAST



THE PAST



THE PAST



THE PAST



THE PRESENT



Over the last 5 years the accurate, stable tendency to increase levels of agricultural production, food-processing, meat-and-milk, canning and other branches of industry was outlined in Ukraine.

That, in turn, has demanded to work out strategy and decision-making policy for restoration and development in our domestic refrigerating industry.


After signing by Ukraine both the Montreal and Kyoto protocols, application of ammonia systems has no alternative and answers initial strategy of refrigerating industry development in Ukraine.

The results of refrigerating plants and industrial cooling systems inspections carried out in different regions of Ukraine by specialists from Odessa State Academy of Refrigeration during 2005-2008 allow to draw the following conclusions:


THE PRESENT

1. **Ammonia charge for operating cooling systems of the industrial and distributive cold stores located mostly within cities border, in some cases reaches 30-50 tons, and as the average value is equal to 5-10 kg per 1 kW of the rated refrigerating capacity (refrigerating power).**
2. **Deterioration of more than 90 % from ammonia compressors exceeds admissible amortization terms (more than 12 years).**
3. **Deterioration of nearly 80 % from heat-exchange apparatus (shell-tube condensers and evaporators, flooded evaporators, evaporative condensers, etc.) is at inadmissible level. There are welded tubes in the majority of shell and tube devices and corrosion for more than 30 % of these devices exceeds all admissible limits.**
4. **Approximately 95 % of ammonia cooling systems work under manual control. At the best cases only primitive monitoring and safety systems are automated. On the 85 % of inspected plants the technologically scheduled parameters control is carried out manually.**


THE PRESENT

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5. On the majority of inspected objects the level of existing heat and moisture flow results in the scheduled temperature level increasing and necessity to set the lower evaporation temperature, which, in turn, considerably raises total energy consumption.
 6. Considerable energy losses are related to complete absence or inadmissible delay in the defrosting of cooling chamber equipment - batteries and air coolers. Practically the defrosting processes are carried out manually on all inspected objects.
 7. Insulation constructions on the majority of inspected refrigerating enterprises are humidified considerably above admissible limits that leads to increasing of heat flow through insulation protections in 1.5...2 times. The especial attention should be paid to infiltration of external air through cracks in the worn out doorways and a thinness in building constructions, also ventilating systems, appeared because of repairs absence.


THE PRESENT

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8. **The present refrigerating industry in Ukraine consists of refrigerating objects placed in separate branches of national economy and trade which are considered in these branches only as the auxiliary links promoting safety production maintenance or production schedules certain parameters maintenance.**
 9. **The refrigerating industry of Ukraine assigned for current and reserve foodstuffs stocks and food raw materials storage, consists of the objects which are included in separate branches of national economy, and is not considered at the state level as the uniform system of storage.**
 10. **The refrigerating economy sphere analysis assigned for fruit-and-vegetable production storage has shown that approximately 60 % of the general system capacity for storage composed by cold storage plants with capacity up to 1500 tons which consume \approx 88 % from the total energy consumption and have production losses equal up to 75-80 % from the total losses in above mentioned storage system. Practically, similar conclusions can be made and for the other branches.**

THE PRESENT

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- 11. Results of the carried out analysis for systems assigned to store agricultural vegetative production have allowed to say:- agricultural production storage system does not have the general strategy for development considering the nation-wide energy and ecological safety requirements, and develops any way, in requirements and possibilities occurrence process in separate country regions; - arbitrary way to build the great amount of small capacity refrigerating plants leads to energy deterioration and system ecological indicators as a whole.**
- 12. Refrigeration plants in Ukraine with identical assignment which were built throughout last 80 years under the various designs considerably differ at technological levels. It allowed to draw a conclusion that even under maintenance of identical parameters of production schedules on all these objects, the possible duration and storage products final quality considerably differ because of unequal heat- and mass transfer conditions. Therefore rationing of losses level and duration of product storage depending on its type and production scheduled parameters based on study results carried out on one object regardless to features and degree of deterioration of other refrigerating objects is unreal.**

THE PRESENT

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13. There is no the Safety Code for ammonia systems in Ukraine. We have only the project under discussion and the latter should be revised and matched to European Codes and Standards.
 14. There is no technical and technological audit system for refrigerating objects in Ukraine results of which could promote development of domestic refrigerating engineering to satisfy the storage system requirements.
 15. All ammonia educational and research laboratories in universities and technical schools have been closed in 2004 by the order from Ukrainian Ministry of Education and Science. Now education and training for: best practices, operating procedures, handling of ammonia and safe operation have stopped completely.

As a result of the above items we could predict and clearly see the vast market potential for the natural refrigeration industry in Ukraine.

THE PRESENT



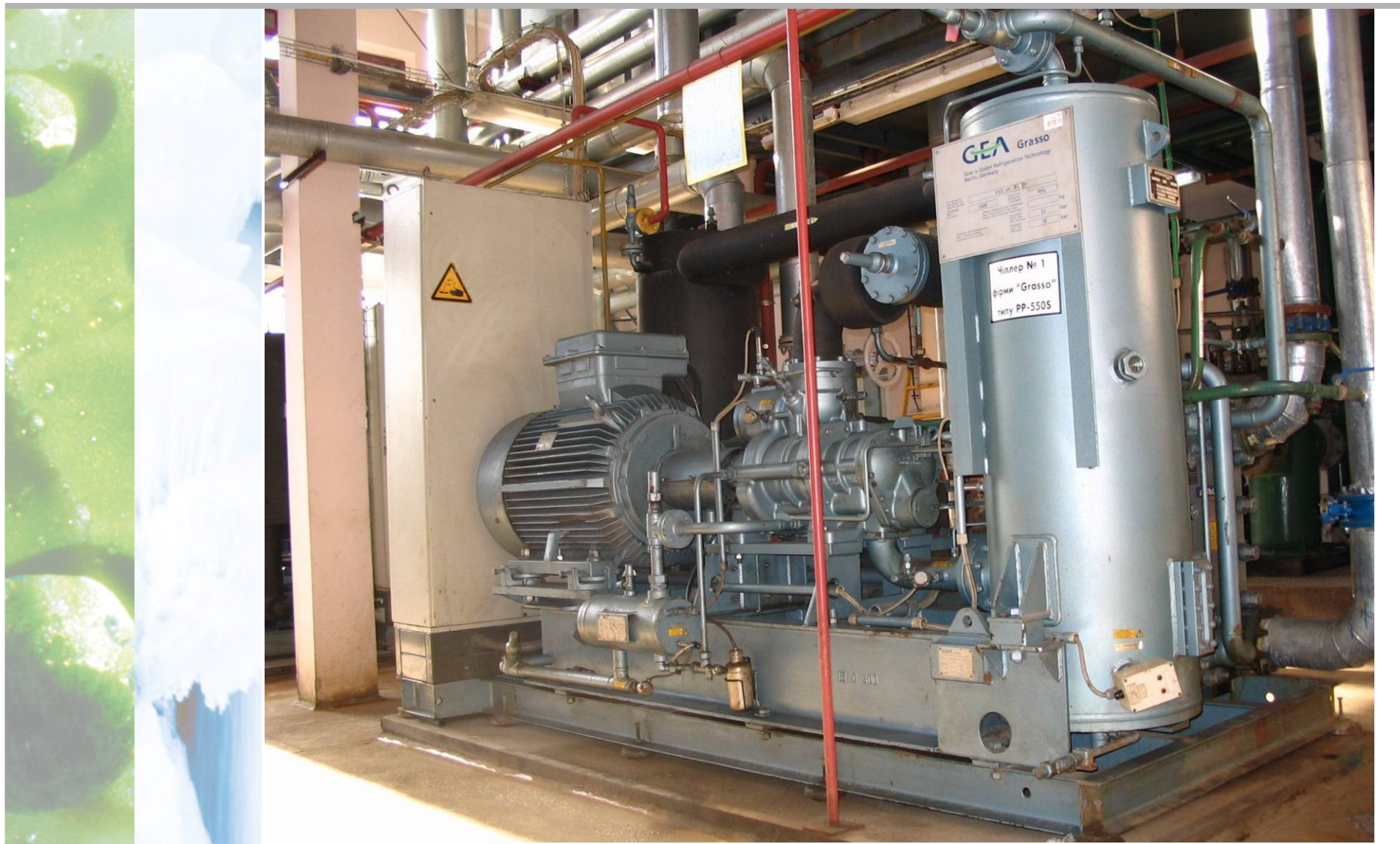
THE PRESENT



THE PRESENT



THE PRESENT



THE PRESENT



THE PRESENT



WHAT SHOULD BE DONE FOR THE FUTURE?

SUGGESTIONS:

1. To develop the technical and technological audit methodology for refrigerating objects taking into account European Community requirements for food ecological and energy safety.
2. To develop the methodology for technological level estimation in refrigerating processing and production storage at refrigerating objects taking into account their criteria of moral and physical deterioration.
3. To develop the methodology of an estimation of food, energy and ecological safety in refrigeration industry as for a whole branch and fundamentals of strategy for its development.

WHAT SHOULD BE DONE FOR THE FUTURE?

CONTINUOUS MEASUREMENT OF ENERGY EFFICIENCY IN REFRIGERATION PLANT

The improvement of the energy efficiency of refrigeration plants is a vital process, since it reduces the main contribution of the refrigeration sector to the global warming. Issues are indirect emissions of CO₂ induced by the consumption of energy needed to operate refrigeration plants. The energy efficiency of a refrigeration plant is measured by using the Coefficient of Performance (COP), which describes the relationship between the refrigeration effect provided by the plant and the energy consumed by the compressor.

We have to be open and recognize that we do not know how the given refrigeration plant works on end-user site in real life from the energy consumption point of view.

Before to say something about energy efficiency we have to measure a value of this parameter !!!

This approach will allow us to have a continuous evaluation of the refrigeration capacity, electrical energy consumption, as well as the performance of refrigeration plants (e.g. specific power consumption per refrigeration output).