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REVIEW ON REFRIGARENT SYSTEM OF CHILLING PLANT USED IN MILK DAIRY

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ABSTRACT
One of the major industry in India is dairy industry. In the dairy industry the milk is cooled by the refrigeration chilling system. Refrigeration is defined as the transfer of heat from a lower temperature to a higher temperature. This is done by the use of refrigeration devices such as compressor, condenser, expansion valve and evaporator. The main component used for the cooling of milk is chiller in a dairy industry. In a chiller milk is cooled up to the 1 degree.

KEYWORD: Chiller, Refrigeration, Cooling, Plate heat exchanger, milk.

INTRODUCTION

India is the largest milk producer as well as consumer of milk and it plays major role in diet and are the most acceptable source of animal protein for large vegetarians of India.This review paper is an attempt to discuss the use of chiller in dairy industry.Importance of milk chilling is In India, there are 14 major milk producing states: Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal which are over 90 percent of total milk production.[1]Chiller is nothing but the heat exchanger which cools the milk in the dairy industry.

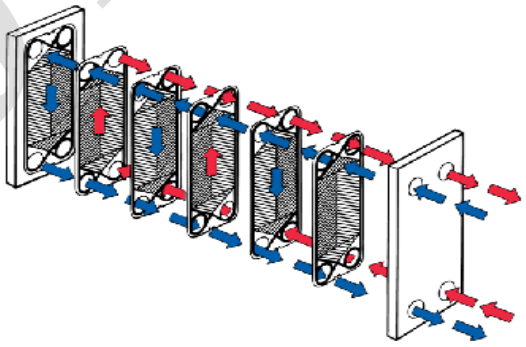

Figure 1.Milk Chiller Used In Dairy

The basic structure of a chiller consists of several parts such as stainless steel plates, with different pressed patterns (for turbulence), stacked together as in the image above. Each of these plates are surrounded with gaskets to control the flow of the fluid. The arrangement of these gaskets is such a way that it allows only one type of fluid , consider milk (to be heated) to spread on one plate, while the other type of fluid , consider hot water, spread on the plate adjacent to it.[1]

Chilling of milk means rapidly cooling of milk to required low temperature so that the micro-organisms present in milk is checked. In chilling process the temperature of milk must be reduced to lower than 10 degree celcious preferably 3 to 4 degree celcious. Milk which is inside the udder is almost sterile and as soon as it leaves the udder, it exposed to atmosphere. The microorganisms gets entry in the milk, the moment it comes in contact to atmosphere.

LITERATURE REVIEW

For the detail study of chillers which is used in the dairy industry it is important to know the previous reaserch done by the various authors.It will help to study the various concepts related to the chiller.so the review done by the various authors are as follows:-

According to Amandeep Sharma and Ravinder Singh Chhina in their paper the effectiveness of a chiller is dependent on the ratio of flow [gpm] inbetween the product and the cooling media. A higher coolant flow rate gives a greater average temperature difference between the milk and coolant and a higher coolant velocity between the plates that it increases the heat transfer coefficient. Many manufacturers suggests that minimum ratio of 2 is essential, it means the water flow doubles the milk flow.The flow of milk from the milk pump to a receiver is intermittent. When level of milk in the receiver reaches at the upper probe, then pump starts. The milk flow could be at least 25 gpm for a few seconds and then stop for a minute. Tests on the two conventional receiver pumps in a double parlor shows that the average milk flow rate during milking was about 12 gpm. Both the receiver pumps operated 26 percent of the time, meaning that the mean flow rate of the milk when a pump was operating was 44 gpm. To achieve a flow ratio of 2, the chilled coolant flow rate while the milk pump was operating should be 88 gpm which is difficult to achieve on a dairy farm.[2]

According to Raymond F- Fuerschbach in their paper chiller has an inlet and outlet which is for a first fluid and there is a passage network there between with the passage network being comprised of various network defining structure, e.g., openings, being present in the flow and heat transfer plates. A similar inlet and outlet and passage network arrangement is provided for a second fluid. Each turbulator member is located in the passage network of one of the fluids with the network so arranged that there is heat transfer between the fluids passing there through. The stacked plates and turbulators are sealingly interconnected to form them together in unitary structure form and the assembly can be provided with top and bottom plates. Where the assembly is interconnected by brazing, a thin braze alloy sheet can during assembly, be intervened between the alternating plates and following subjection of the assembly to a heated brazing environment, the braze alloy sheets will form alloy layers adhering to adjoining faces of the plates and also fluid-tightly seal the peripheral regions of the plate interfacings.[3]

According to John f Banks, of bluffton, texas their invention is an improvement in that particular class of milk-coolers in which water is drawn by capillary attraction from a receptacle placed above the milk-receptacle onto a cloth wrapped around the latter, thus cooling' the milk by evaporation.In their invention the water- receptacle is adapted to fit into milk-receptacles of various sizes, and the cloth by which the water is drawn off is removably secured around a central vertical tube forming a permanent attachment of said water-receptacle, all as here inafter more fully described.It was seen that their milk-cooler is very simple and cheap in construction, and that it can be fitted instantly to any plain ordinary bucket, and will transform a common bucket into a perfect milk-cooler. Thus, the amount of water drawn from the top and fed down the sides of the bucket can be regulated precisely and very readily by drawing one, two, or more of the points 12 from their cord 13 and lifting them out of the water. It will thus be seen that only enough of the points12 can be fastened in the water to carry as much as water down the sides of the bucket as will be evaporated, this amount varying according to the state of the Weather. In a milk-cooler, the combination of a bucket at the top or water-receptacle having the inclined sides, the upper edge flange, the central opening, and the central tube having the Wire-gauze atits upper end, and the cloths 11, formed at their upper ends with the se ries of separate tongues or points 12, and securing-cords 13, on which the free ends of l the tongues 12 are removably secured, sub~ stantially as set forth.[4]

According to Joi-In Barnhart, David A. Barnhart, And James W. Carni-Iart, Or Williamson, Pennsylvania Their invention result relates to certain new and useful improvements in coolers, and especially for a milk-

cooler, by which provision is made to allow a running current of water to pass through a tank having suitable partitions between which the can of milk may be held on suitable racks and so constructed that water which is fed to the tank may pass over and under alternate partitions, so as to take up the heat which is radiated from the milk and to pass out the opposite end of the tank from which it enters, thus supplying a constant current of cold water to the sides and bottoms of the cooling-receptacles A further part of their invention consists in the provision of means for separating or spreading the water as it is fed to the tank so that it will enter the same in a sheet of water extending the entire width of the tank.To these ends and to such others as the invention may pertain the same consists, further, in the novel construction, combination, and adaptation of parts, as will be herein after more fully described, and then specific ally defined in the appended claim.[5]

According to John George Kaestner, Baltimore, Md., assignor to The E. A; Kaestner Company, Baltimore, Md., a corporation of Maryland Their invention result involves improvements in milk coolers or other heat exchange organizations that are subject to 'substantially like conditions when in use and the objects and nature of the invention will be understood by those skilled in the art in light of the following explanations of the accompanying drawings that illustrate what he now believe to be the preferred mechanical expression or embodiment of the invention from among other forms, constructions and arrangements within the spirit and scope of the invention. An object of the invention Vis to so improve milk coolers and the like heat exchange organizations as to eliminate or reduce to the minimum electrolytic action tending to break down joints or that otherwise tends to shorten the effectively life of such coolers and other heat exchange organizations and to eliminate the deteriorating action of milk and acids therein on the metals included in the cooler structure and on the metallic surfaces of such coolers which the milk contacts. And a further object of the invention is to so 25 improve the construction of milk coolers and the like,that stainless steel can be economically employed to the exclusion of other metals or materials in such combination with the stainless , steel units or parts as might result in electrolytic 30 action due to the presence of acids and other substances presents in milk. And a further object of the invention is to provide certain improvements in structure, organization and assembly to produce a highly desirable and efficient milk cooler and in the method of producing the same.[6]

According to William R. Henry in their paper it conclude that a chiller plant which produces chilled Water for Field of air conditioning, or an industrial process and Which is comprised of chillers, cooling fluid pumps, and cooling towers uses a substantial amount of energy. A method that used for the operation of the cooling tower, cooling fluid pumps, and refrigeration machines so that the chiller plant operates at a higher overall efficiency thus reducing the power usage has been developed and is presented therein. The flow rate of the cooling fluid pumps are controlled to maintain a precise temperature difference across the refrigerant condenser. The cooling tower fans are controlled by comparing the cooling fluid temperature and the cooling fluid flow rate to selected design parameters. The heat rejection rate is measured for each chiller in the chiller plant and operating set points are established for each operating chiller to provide the optimum operation for best energy efficiency.The chiller plant may also include a plurality of chillers, pumps, and cooling towers. For instance multiple chillers can be operated in parallel, With a single cooling fluid piping circuit connecting all chillers to the same cooling tower. Another systemhas a separate fluid cooling circuit, and separate cooling tower for each individual chiller in the chiller plant.[8]

According to B. Bansal and X. D. Chen their review focuses on the mechanisms of milk fouling, detailing the role of protein denaturation and aggregation reactions as well as mass transfer. It has also been endeavoured to review the effect of a number of different factors on milk fouling. These factors have been divided into five major categories: milk composition, operating conditions, heat exchanger characteristics, presence of micro-organisms, and location of fouling. In the dairy industry, thermal processing is an energy intensive process since every product is heated at least once (de Jong 1997). Processing over 13 billion litres of milk every year in New Zealand (Fonterra 2004) means the efficiency of the heating process is of paramount importance. Fouling of heat exchangers is a serious issue as it reduces heat transfer efficiency and increases pressure drop and due to this affects the economy of processing plant (Müller-steinhagen 1993, Toyoda et al. 1994). As a result of fouling, there is a possibility of deterioration in product quality since the process fluid cannot be heated up to the required temperature. The deposits dislodged by the flowing fluid can also cause contamination. hen et al. (2001) proposed, based on their experimental data,

that fouling was caused by both denatured and aggregated whey proteins and perhaps primarily influenced by the presence of the denatured (but not the aggregated) proteins in the bulk. They also included the mechanism of the reversible formulation in the protein denaturation process.[11]

According to Peter Thatcher in his theory Glycol chillers are key components to long draw dispense systems. Chilled glycolalways helps to maintain the temperature of draught beer in the beer lines between the keg and the faucet. Glycol chillers are much less expensive to maintain than they are to replace regular maintenance would increase both their service life and dependability. Here are some recommended maintenance practices; be sure to check with your manufacturer for items and procedures specific to your chillers.Glycol refrigeration systems are one of the most environmental friendly refrigeration systems; they also offer enhanced performance and significantly reduced energy consumption.A glycol system consists of linking a number of independently controlled refrigerated cold rooms, refrigerated cabinets or bottle coolers together. A chilled glycol solution is then circulated within a closed loop ring main using a specialized chiller, which includes the refrigeration system, circulation pumps and internal expansion holding tank. The chiller uses an overall smaller amount refrigeration charge than a traditional multi-link system. The main chiller units are designed to be located externally or internally in a plant room. They chill the glycol solution via dual plate heat exchangers connected to a direct expansion refrigeration system with a common enclosure, with our chiller using the dual compressor and circulation pump system offering the perfect solution for safety and power savings. [12]

CONCLUSION

Conclusion can be drawn from the literature review carried above that the milk chiller is a device which is widely used in a dairy industry for the chilling of the milk which is efficiently work and cools the milk for the required temperature.

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