Introduction from a heat source to a heat

INTRODUCTIONIn present scenario everybody in world concernedabout globalwarming, ozone layerdepletion, greenhouse gases, deforestation and many morethings happens after the industrialization and revolution. Many new ways were camein existence for reducing the pollution. Renewable energy attracts attention ofpeople and scientists.

Geothermal energy is one of best gift of earth. Thisenergy can be used without any disturbance to environment. The adjective geothermal originatesfrom the Greek roots ??(ge), meaning earth, and ??????(thermos), meaning hot. Heat is a form of energy and geothermal energy is, literally, the heat contained within the Earth that generates geologicalphenomena on a planetary scale (Dickson and fanelli, 2004).

(Geothermal energy is not only available in the formof volcanoes, hot water streams, but whole earth surface is a source of energythroughout the year.)Temperature of earth below 2 – 3 meterremains in the particular range throughout the year. At 3 m depth it is between 24ºC and 29. 8ºC. The strata between 2-3 m appear well suitedfor sitting of earth tube heatexchanger (Sharan and Jadhav. 2002).

Geothermal heating and cooling involves the use ofconstant heat (geothermal energy) that exists two to three metres below groundfor heating and cooling purposes (stein, 2013). It can be describedschematically as ‘ convecting water in the upper crust of the Earth, which, in aconfined space, transfers heat from a heat source to a heat sink, usually thefree surface’. (Hochstein etal., 1990) UTILIZATION OF GEOTHERMAL RESOURCESThe Lindal diagramemphasises twoimportant aspects of the utilization of geothermal resources(a) with cascadingand combined uses it is possible to enhance the feasibility of geothermalprojects and (b) the resource temperature may limit the possibleuses(Gudmundsson, 1988).

1. Electricitygeneration mainly takes place in conventional steam turbines and binaryplants, depending on the characteristics of the geothermal resource. 2. Direct heat use is one of the oldest, most versatile and alsothe most common form of utilization of geothermal energy. Bathing, spaceheating and district heating, agricultural applications, aquaculture and someindustrial uses are the best known forms of utilization, but heat pumps are themost widespread.

There are many other types of utilization, on a much smallerscale, some of which are unusual. 3. Spacecooling is a feasible option where absorption machines can be adaptedtogeothermal use. Thetechnology of these machines is well known, and they arereadily available in the market. The absorption cycle is a process thatutilises heat instead ofelectricity as the energy source(Sanner, et al. 2003). 4.

Ground-coupledand ground-water heat pump systems have now been installed in great numbers inat least 30 countries, for a total thermal capacity of more than 9500 MWt (in2003) (Lund et al. 2003). 5. Agricultural applicationsof geothermal fluids consistof open-field agriculture and greenhouse heating. Thermal water can be used inopen-field agriculture to irrigateand/or heat the soil (Barbier and Fanelli, 1977).

6. Farm animalsand aquatic species, as well as vegetablesand plants, can benefit in qualityand quantity from optimum conditioning oftheir

environmental temperature. In many cases geothermal waters could be usedprofitably in a combination of animalhusbandry and geothermal greenhouses (Barbierand Fanelli, 1977). GEOTHERMAL HEATING AND COOLING SYSTEMGeothermal Heating and Cooling Systems provide space conditioningheating, cooling, and humidity control. They may also provide water heatingeither to supplement or replace conventional water heaters.

Geothermal Heatingand Cooling Systems work by moving of heat, rather than by converting chemicalenergy to heat like in a furnace. Every Geothermal Heating and Cooling Systemshas three major subsystems or parts: a geothermal heat pump to move heatbetween the building and the fluid in the earth connection, an earth connectionfor transferring heat between its fluid and the earth, and a distributionsubsystem for delivering heating or cooling to the building. Geothermal system componentsa.)Ground loop A closed ground loop systemconsists of a series of high density polyethylene pipes buried in a yard. Aheat transfer fluid, comprised of antifreeze and water, is inside the groundloop pipes. This heat transfer fluid removes heat from (heating mode) ordelivers heat to (cooling mode) the earth surrounding the ground loop.

Theground loop pipes carry the heated fluid to the heat pump furnace unit in thehome (MH, 2017). b.)GeothermalHeat Pump The heat pump's systemimproves the consistency of the heat, which is then circulated throughout the animalhouse by way of the distribution system. The heat pump furnace unit providesboth heating and cooling. Thegeothermal heat pump is packaged in a single cabinet, and includes thecompressor, loop-to-refrigerant heat exchanger, and controls(MH, 2017).

c.)DistributionSubsystem In a forced air system, a fan in the heat pump furnace unit blows air over a fan coil and the heated orcooled air is distributed through the ductwork(MH, 2017).

DifferentTypes of geothermal ventilation Systems Geothermalsystems use the earth as a heat source and heat sink. A series of pipes, commonly called a " loop," carry a fluid used to connect thegeothermal system's heat pump to the earth. There aretwo basic types of loops: closed and open, where as other variants are alsopresent. Openloop systems Open loopsystemsare the simplest.

Used successfully for decades, ground water is drawnfrom an aquifer through one well, passes through the heat pump's heatexchanger, and is discharged to the same aquifer through a second well at adistance from the first. Open-loop systems have a very highthermal efficiency and installation can be up to 50% less expensive thanvertical closed loop systems. Openloop systems have challenges like some local ground water chemical conditionscan lead to fouling the heat pump's heat exchanger. Increasing environmentalconcerns mean that local officials must be consulted to assure compliance withregulations concerning water use and acceptable water discharge methods(Waleand Attar, 2013). Closedloop systemClosed loop systems are becoming the most common.

Whenproperly installed, they are economical, efficient, and reliable. Water (or awater and antifreeze solution) is circulated through a continuous buried pipe keeping. The closed loop system is environment friendly because water in the loopprevents contamination to the external environment. The length of loop pipingvaries depending on ground temperature, thermal conductivity of the ground, soil moisture, and system design(Wale and Attar, 2013). HorizontalLoopsHorizontal closed loop installations are generallymost cost-effective for small installations, particularly for new constructionwhere sufficient land area is available. These installations involve buryingpipe in trenches dug with back-hoes or chain trenchers.

Up to six pipes, usually in parallel connections, are buried in each trench, with minimumseparations of a foot between pipes and ten to fifteen feet between trenches(Waleand Attar, 2013). VerticalLoopsVertical closed loops are preferred in many situationslike small farm size or no more land is available for further enhancement. Verticalloops also minimize the disturbance to existing landscaping. For verticalclosed loop systems, a U-tube(more rarely, two U-tubes) is installed in a welldrilled 100 to 400 feet deep. Because conditions in the ground may varygreatly, loop lengths can range from 130 to 300 feet per ton of heat exchange. Multiple drill holes are required for most installations, where the pipes aregenerally joined in parallel or series-parallel configurations(Wale andAttar, 2013).

Slinkyloops: Increasingly, “ slinky” coils overlapping coils ofpolyethylene pipe are used to increase the heat exchange per foot of trench, but require more pipe per ton of capacity. Two pipe systems may require 200 to300 feet of trench per ton of nominal heat exchange capacity. The trench lengthdecreases as the number of pipes in the trench increases or as Slinky coil overlapsincreases.

Thissame slinky coil design-system can be used in a lake or pond application(Wale and Attar, 2013). PondloopsPond closed loops are a special kind of closed loopsystem. Where there is a pond or stream that is deep enough and with enoughflow, closed loop coils can be placed on the pond bottom. Fluid is pumped justas for a conventional closed loop ground system where conditions are suitable, the economics are very attractive, and no aquatic system impacts have beenshown (Wale and Attar, 2013).

Anatomy of aGeothermal Heat Pump (GHP)Instead of producingheat like a conventional furnace, a geothermal system moves heat from one placeto another. Ø The cool, liquid refrigerant enters the indoor coilduring cooling. As it enters the coil, the temperature of the refrigerant isbetween 40o and 50o F. Ø As warm, moist room air passes over the cool coil, the refrigerant inside absorbs the heat. Ø The new cooler, drierair is circulated back intothe room with a blower fan. Ø The refrigerant moves into the compressor, which isa pump that raises the pressure so it will move through the system.

Theincreased pressure from the compressor causes the refrigerant to heat toroughly 120º to 140º F. Ø The hot vapor now moves into the condenser (theunderground loops), where the refrigerant gives up its heat to the coolerground and condenses back into a liquid. Ø During the winter, the reversing valve switches theindoor coil to function as the condenser, and the underground piping to act asthe evaporator. Ø As the refrigerant leaves the compressor, it'sstill under high pressure. It reaches the expansion valve, where the pressureis reduced.

Ø The cycle is complete as the cool, liquidrefrigerant re-enters the evaporator to pick up room heat. Ø During the winter, the reversing valve switches theindoor coil to function as the condenser, and the underground piping to act asthe evaporator. Ø In short, the indoorcoil and underground piping cause the refrigerant to change state, absorbingand releasing heat through boiling and condensing.

The compressor and expansionvalve move the refrigerant through the system by changing the pressure(Wale and Attar, 2013). Calculationof geothermal ventilation and energy requirement: The ventilation required for thebird/animal is found using this equation: V?= no. of birds/animals X average body weight X flow rate per kg Geothermal energy suppliesTocalculate this amountof heat that can be supplied to the house we use the following equation: QGeo= m. GeoX C? X (TGeo– Ti) Where, QGeo = Water temperature(oC)m.

Geo = Ground water mass flow rate (kg/s) C? = Airspecific heat (kJ/kg. K) TGeo = Groundwater temperature (oC)(Busouland Elayyan, 2014) ADVANTAGES OF GEOTHERMAL SYSTEMSEfficiency: energyefficiency ratio of geothermal ventilation system compare to electrical heatingat different temperature (°C) like 32. 2, 37. 7, 43. 3 is 17 and 10. 5, 9, 8, respectively(Choudhury, 2013). Reliability and safety: Geothermal heating and coolingsystems have few moving parts, so they are highly reliable.

There is no risk ofvandalism. Geothermal heating systems can last far longer than most heatingsystems up to 25-50 years. It will also eliminate the risk of carbon monoxidepoisoning associated with natural gas heating and hot water. The risk of firesis also much lower than in an animal house equipped with a gas furnace and/orgas water heater. Flexibility and convenience: Geothermal heat pumps can be set upto supply hot water as well as space heating and cooling. In some cases, thehot water comes at no additional energy cost. Geothermal heating and coolingsystems create no noise outside the home, and almost no noise inside either(Choudhury, 2013). Renewable energy: Geothermal is a renewable source ofenergy for heating, cooling, and air conditioning.

There is no pollution causedand no any adverse effects on flora or fauna. Geothermal heating and coolingsystems do not contribute to global warming (Choudhury, 2013). Financial: Although geothermal systems can cost severaltimes what a conventional system costs, payback can be within 2-10 yearsaccording to some estimates. This system is more economical as compared to heatingventilation and air cooling (HVAC) system (Choudhury, 2013). DISADVANTAGESOF GEOTHERMAL SYSTEMS1. Expensive: These systems are very expensive to install. 2. Installation disturbance: During the time of installation trenching isrequired for loop establishment it will disturb the land structure.

In case ofhorizontal loop system disruption of landscape is seen. 3. Environmental disadvantages ofgeothermal systems using direct exchange (DX): Use of copper pipes to circulate the refrigerant, andcopper pipes buried under ground can easily corrode over time, leading to leaksthat are hard to locate and almost impossible to fix (GEEH, 2016).

ENVIRONMENTAL EFFECTS The environmental effects of geothermal developmentand power changes in land use associated with exploration andplantconstruction, noise and sight pollution, thedischarge of water and gases, theproduction of foulodor, and soil subsidence. Most of those effects, however, canbe mitigated with current technology sothat geothermal uses have no more than aminimalimpact on the environment. For example, KlamathFalls, Oregon, hasapproximately 600 geothermal wellsfor residential space heatingIn addition, GHPs have a very minimal effect on theenvironment, because they make use ofshallow geothermal resources within 100 meters(about 330 feet) of the surface. GHPscause only small temperature changes tothe groundwater or rocks and soil in the ground (EB, 2017).

Geothermal HVAC Myths BustedThereare many myths about the geothermal ventilation system like geothermal energyis just experimental and can’t be used widely. Geothermal resources arenonrenewable. Extraction and injection of geothermal brines will contaminatesthe drinking water. Geothermal ventilation development will disturbs the land features.

Geothermal ventilation is applicable only in temperate region of earth. Geothermal ventilation system can’t cool the home it will only heat the room(Egg, 2013). Morrisonand Ahmed, (2010) reported myth about GHPS that the technology is tooexpensive.

The technology doesn’t work in India. Geothermal HVAC requiresgeothermal energy to operate.   Geothermal system in different animal houseShah, et al.,(2017) found that earth-to-water heat exchanger(EWHE) pens wereslightly warmer than the Control pens cooled with stir fans and sprinklers invery hot days, pig performance in the EWHE pens was unaffected. The EWHEreduced the electricity use by > 50 per cent and eliminated the sprinklingwater use.

EWHE is sustainable and cost effective for high value pig andgreenhouse in any part of the world. KankariyaZoo, Ahmedabad has initiated a project to develop a nocturnal animal house withthe geothermal ventilation system for providing a fresh air at ideal temperaturewhich is good for the under danger wild animal species (IE, 2017). Geothermalcooling system potentially reduces the cost of energy about 28 per cent ascompared to conventional heating system.

Geothermal ventilation suppresses theemissions of (NH_3, H_2S, SO_2) and also the riskof microbial contaminant into the animal house environment. It has no anynegative impact on the growth performance of the growing pigs. (Bostami etal. 2016). They further suggested that, geothermal system was moreeffective in maintenance ofinternal house temperature compared to groundchannel; whereas, ground channel system was more effective in savingenergyconsumption and reducing CO_2 emissions. Thus, on a broader view, geothermal andground channel system can contribute to the global energycrisisand global gas emissions reduction through potentialsaving of energy consumptionand reduction of CO_2 and odorous gas emissions (Bostami et al. 2016).

Islam,(2016) found that the CSGHP system has the potential to reduce electricity use, overall cost and CO and noxious gas emissions. Therefore, the CSGHP system hasthe potential for use as an environmentally friendly renewable energy sourcefor animal houses. CopenhagenZoo had conducted a project for preliminary study of geothermal ventilationsystem for their zoo animals and birds. They have done project for penguinexhibition and they have save about 142 MWh energy per year (Hestmark etal.

, 2015). Use of a modular housing with GHE may be more effective for heat-intensivepiglet production. The investment costs are higher than in comparableconventional livestock buildings. The modular housing with integrated GHE isassessed as positive from energy and environmental point of view for pig houseswhere high indoor temperatures are required on a year-round basis(Krommweh etal., 2014). Predicalaet al.

, (2014) conducted an experiment on swine barn and found thatgeothermal ventilation system is more significant than the convention gas firedheater, GSHP room was cooler during the warm months there were no considerabledifference between two rooms during cold months. Methane and Nitrous Oxideconcentrations were lower in GSHP room compare to conventional ventilationsystem. With the geothermal ventilation system no any type of adverse effect onpig's average daily gain, feed intake and feed conversion efficiency.

Geothermalventilation loop have multiple use for example in Oregon zoo they had develop amultilateral ground loop which provide a cool environment to bear and warmenvironment for elephants (OZ, 2014). Astudy conducted at Chumathang, Himachal Pradesh, to know the energy cost perunit exergy for parallel combination of a phase change system with a heatingsystem. At low flow rate and -5°(C) ambient temperaturecost per unit exergy were 0. 32 and 0.

69 (USD MJ-1 hr-1), respectively (Chauhan, 2013). Stein, (2013) reported thatUniversity of Missouri, has developed a geothermal energy system for a largeturkey farm in that state. The project has been jointly funded by the USDepartment of Energy as a demonstration project in partnership with the farm’sowner.

The system is being used both for brooding and grow-out. The projectteam estimates that they will save on energy costs between 50 and 70 per cent. Ithas been concluded that a GHP system couldincrease the production performanceof broiler chicksdue to increased inside air quality of the broiler house. TheGHP system had lower CO2 and NH3 emissionswith lowerenergy cost than the conventional heatingsystem for broiler chickens (Choietal., 2012). Jacobson, (2012) suggested thatthere are cooling alternatives to the traditional evaporative systems used inpig facilities in the Midwestern USA and other pig growing areas of the worldthat could result in reduced energy and emissions per pound of pork producedwhile still being economically viable.

A geothermal system was evaluated as onepossible method to provide cooling for pig buildings that could provide aneffective and economicapproach to cooling pig facilities. In acomparative study between the ground source heat pump(GSHP) heating and coolingsystem, coal fired heating system(CFH), wet curtain fan cooling system(WCFC), air conditioning found that initial investment of GSHP heating and coolingsystem was higher than that of the CFH system integrated with WCFC system, therelative operating cost of GSHP, CFH and AC was 0. 94, 1. 00, 0.

98, respectively(Wang et. al., 2012). Ina case study of poultry farm in Syria came to a conclusion that coefficient ofperformance of GSHP for heating and cooling were 6. 2 and 10 respectively, whilecorresponding values of ASHP were 4 and 4. 3 only.

Also found that annual cost of GSHP isreduced up to 38 per cent, 69. 2 per cent, and 79. 7 per cent as compared toASHP, coal heater combined with ASHP and diesel heater combined with ASHP, respectively (Mohamad, 2012) CONCLUSIONIn recent era of energy crisis geothermal ventilationsystem is a good alternative.

Geothermal ventilation will reduce the greenhouseeffect by reducing the production of greenhouse gases like CFC and HCFC etc. Geothermal ventilation reduces the emission of harmful gasses and also risk ofmicrobial contamination into the farm shed. Geothermal ventilation provides naturalair with improved quality which is favourable to maintain animal growth andhealth.

It is efficient, safe, flexible source of renewable energy. Geothermalventilation system is best alternative to create favourable microclimaticcondition in animal house during adverse climate.