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Identification of Some of Low Temperature Waste Heat Utilization Potentials in Indian Industries

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----------ABSTRACT----------
This study is related to Identification of low temperature waste heat recovery potential and its effective utilization for efficiency improvement in Industries in Typical Indian Conditions. The low grade heat resources are various in different Industries and due to lack of knowledge, technology, these sources are presently untapped , if utilized will result in reduction in fuel consumption. This paper identifies some of such waste heat potential in Some Industries like Hospitality ,small and medium Industries of molding ,metal and re melting . These recommendations may be replicated to similar to other Industries and Establishment where similar process of Energy uses and waste heat potential exists.

KEYWORDS: *Waste heat ,laundry, Tumbler, vacuum distillation ,LPG*

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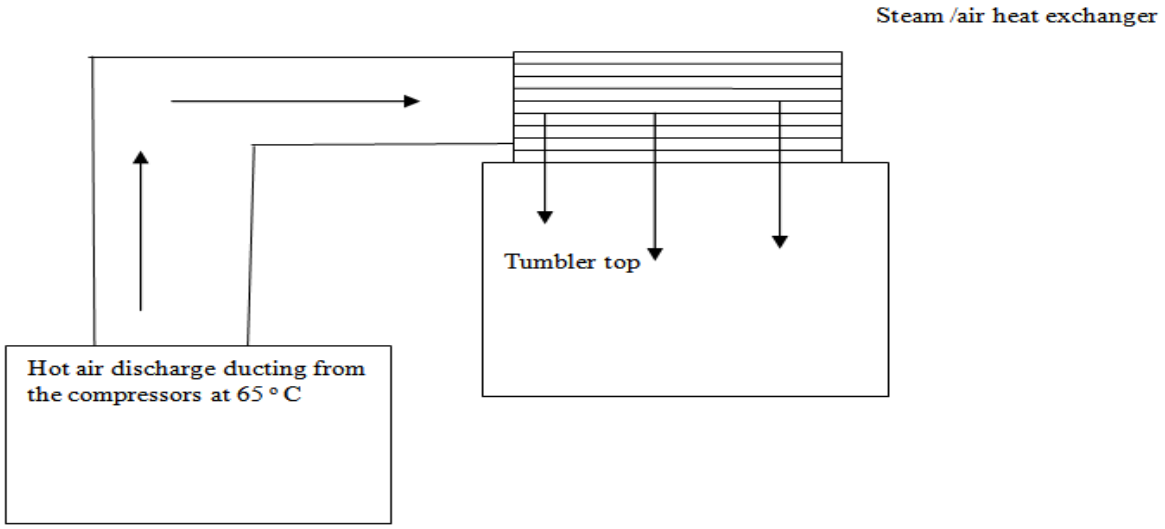
I. INTRODUCTION

Generally based upon the potential of waste temperature sources, the waste heat has been identified as High, low and medium temperature waste heat . The High and medium temperature waste heat sources of identified processes have been well researched and fully developed technology is available to tap the these sources, however the low temperature waste heat sources ,which consists of majority of waste heat rejection , has not been fully addressed . The technology which can be effectively used in colder places can not be utilized in places like in Northern India. The reason being due to high Environmental Temperature, The low Temperature waste heat recovery have lesser scope for use in warmer Countries like India. This study is related to low temperature waste heat recovery and its effective utilization for efficiency improvement in Industries in Typical Indian Conditions. The low grade heat resources are various in different Industries and due to lack of knowledge, availability of technology, these sources are presently untapped , if utilized will result in reduction in fuel consumption. This paper identifies some of such waste heat potential in Some Industries like Hospitality ,small and big Industries. These recommendations may be replicated to similar other Industries and Establishment where similar process of Energy uses and waste heat potential exists.

(a)This case relates to a hotel ,where , a compressor is used to supply compressed air for use in laundry. The hot air discharge is at 65 ^{o} C. The Laundry uses steam at 150 ^{o} C to heat atmospheric air in fined heat exchanger ,before same is induced to Tumbler for wet cloth drying . It can be used as preheated air before steam to air heat exchanger . This will result in reduction of steam consumption in the drying of cloths . Since the major part of steam consumption is in the drying process. The arrangement may be made as follows:



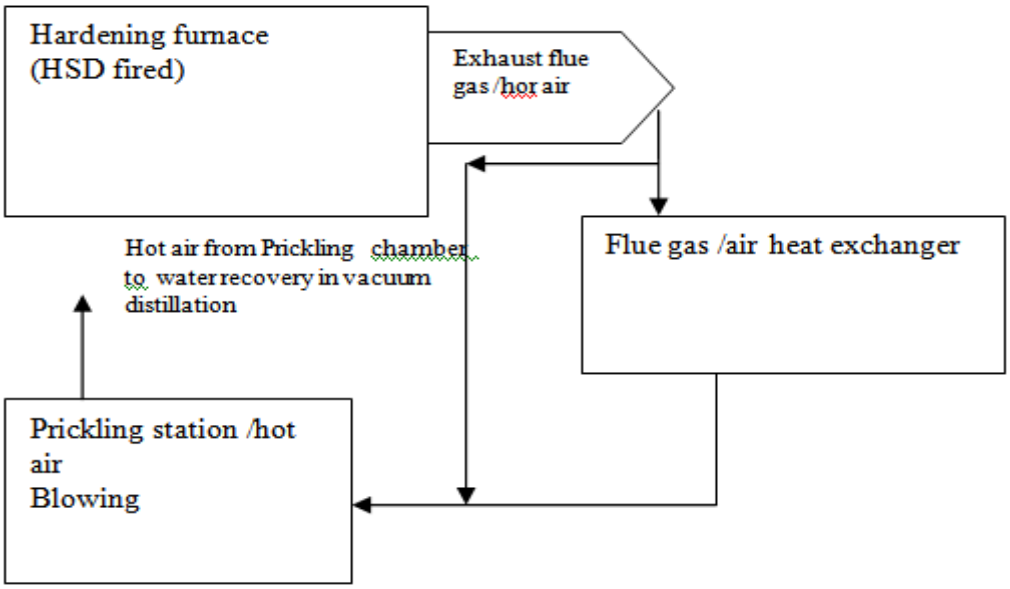
The individual tumbler top has opening cover and the air is sucked only when the hot air flow is required. In this case the hot air ducting coming from the compressor is to be provided with option of diverting the air to tumbler discharge ducting when non of the Tumbler is in operation. This arrangement will help to reduce the steam consumption in Laundry. The potential saving identified in a gas fired steam generator required for heating air will be Rs200036.53. Further with the investment of Rs 200000in providing ducting ,the pay back period will be around one year.

(b) This case also refers to Waste heat reject from compressors in a molding Industry . It is noted that in molding Industry one or two dish/bin washing machines are Installed . These are run every now and then to wash the plastic containers. In the process of washing water is heated to 50^{o}C temperature .A typical Industry in study around 60liters of water is heated at the required temperature with the help of 6 numbers of 3kw Electrical Heaters. This heating can be achieved by hot air discharge from the compressor which is other wise discharged in the atmosphere, this way saving in terms of electrical energy can be achieved. However since the operation of the washing machine is not for longer duration therefore investment to switch over for suggested heating may have longer pay back periods.

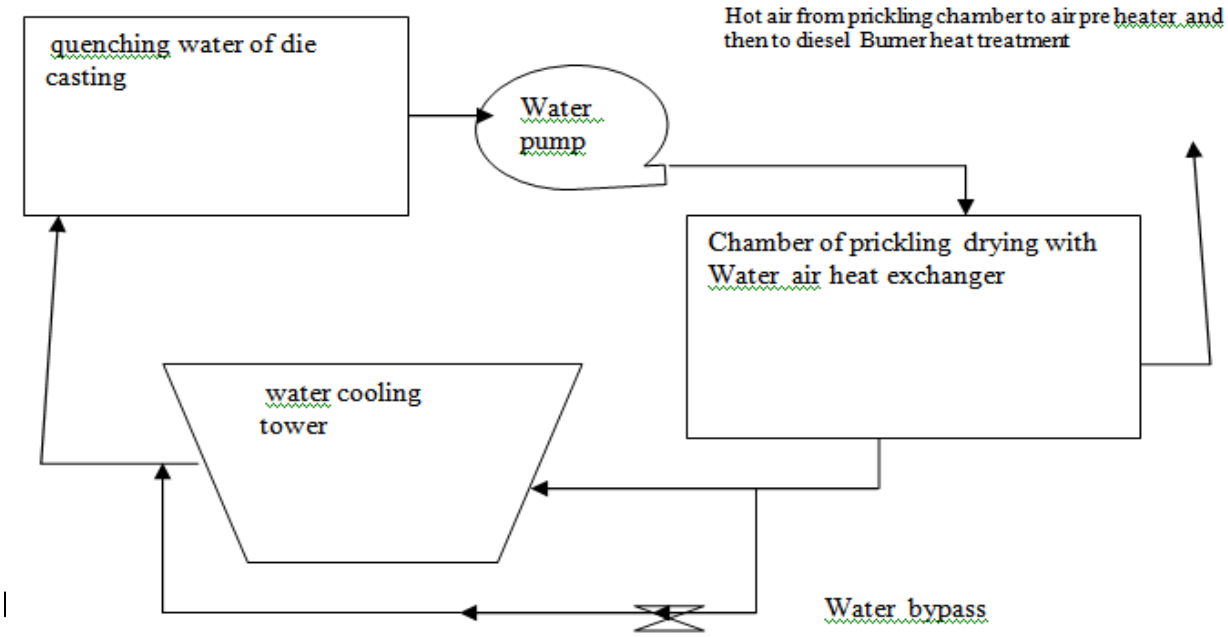
Alternatively it is noted that there is very appreciable quantity of Dematerialized water consumption in the plant Thus average annual consumption of DM water is 542.88Tones and charges are Rs163008/Annam. This requirement can be achieved by using waste heat based distillation of cooling water coming out of machines. This way the waste heat reject of machines and compressor can be utilized in low temperature vacuum distillation and there will be no Demand of Dematerialized water to be purchased from outside. The cost of such low temperature waste heat based vacuum distillatory will be around Rs1000000 and pay back period will be 6.13 years. The IRR @ 12% discounting is just 2.47%. However it is attractive to note that waste heat will be utilized and out side dependency to demoralized water will be reduced/stopped.

(c)

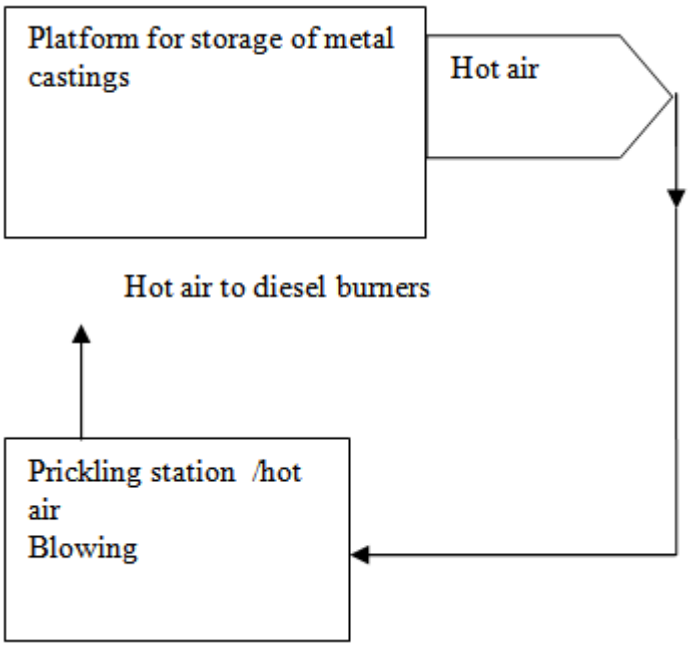
The industry in study is involved in melting of brass, copper ,zink scraps and metals and scraps purchased from the market melted and reshaped for further uses. The processes being followed in the industry are melting of scrap and metal pieces to provide a shape by casting for rolling, ,then heat treatment for stress relieving and prickling for surface cleaning . The Melting furnaces are induction type electrical furnace., the Heat treatment furnaces are diesel fired. Further in the same Industry the Hot water for quenching in die casting is available in temperature range of 45-50^{o}c, is passed through cooling tower to reduce its temperature for further uses. The heat instead of wasting in the atmosphere can be utilized to generate distilled water in waste heat based vacuum distillation .This will reduce the cost of electricity used in running cooling towers. Presently the prickling station has heating arrangement with 96 KW electrical heater and one station with facility of Natural Gas heater. This requirement can be met by use of waste heat of annealing caste blocks, rolled pieces , exhaust gases/flue gases from the annealing/heat treatment stations through air /flue gas heat exchangers by passing the air over the left over casted blocks, rolled pieces and then pass this hot air at prickling station for drying etc. Induction cooling air discharge which is available at around 80-90 ^{o}c also can be utilized to provide heat to replace 45 KW electrical heater meant for prickling station. The arrangement can be following type:



(ii)Alternatively the hot quenching water of die casting in melting furnaces available at 50^{o}c can be circulated through a water to air heat exchanger to preheat the air before further passing it over the rolled coils to gain further temperature before finally passing it through prickling station .The blown air in hot drying chamber can be led to the Air pre heater of furnaces and then to burners or for water recovery as suggested in at (i) above..

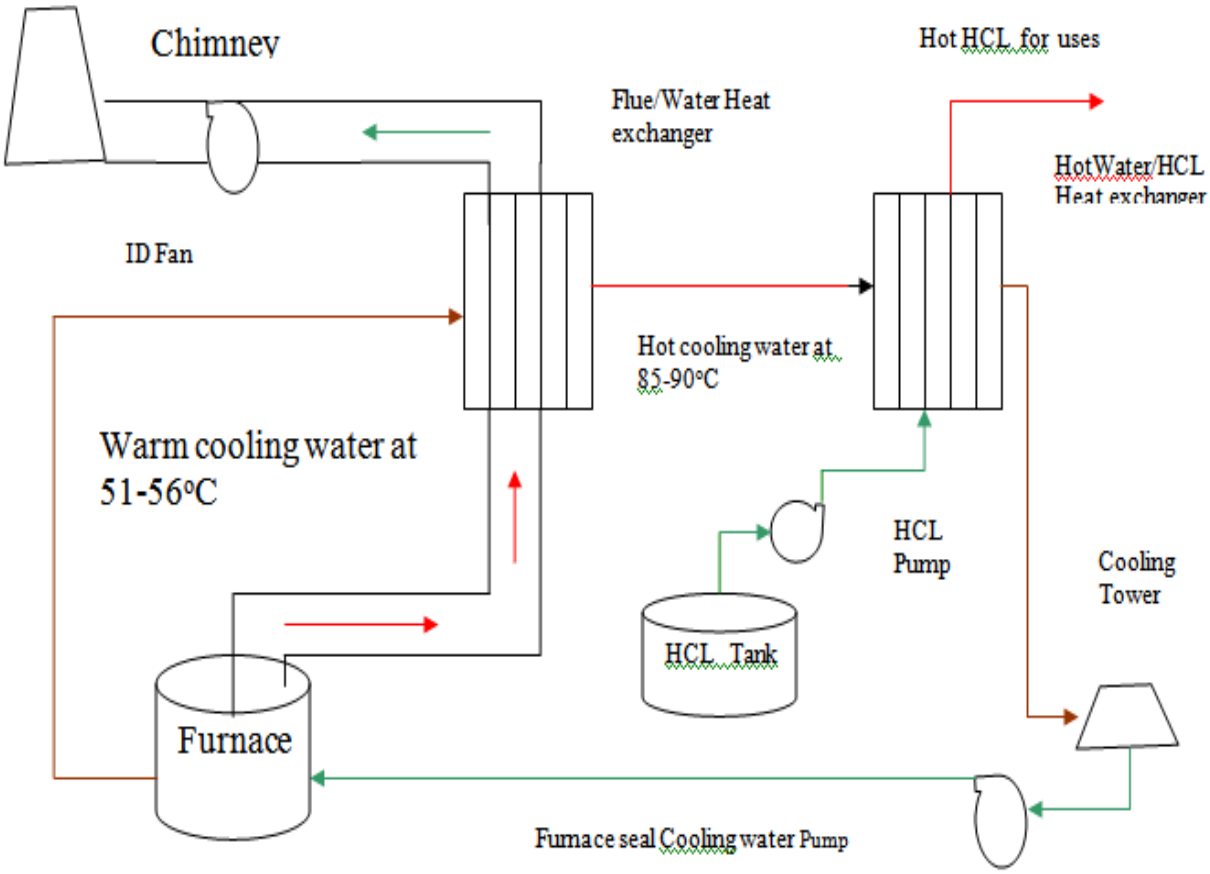


(iii) The hot blocks of metal casting are stored in such Industry at a specified place to cool down to room temperature by annealing process. The heat available to be utilized as sensible heat from casting , which is stored in open air before put to further process. These sources of heat can be stored at the nearest point at pre fabricated platform where from the cold air is blown. This air is then compressed and blown to prickling chamber. The return hot air from the prickling chamber can be circulated through air pre heater and then to burner of diesel fired heat treatment furnaces.



The annual saving in above arrangement is estimated to be 45 KW of electricity with total 224640 units of electricity at the @ 16 hrs per day effective operation of heaters and factory operating 6 days a week. The total cost saving will Rs 1347840.00 with investment of Rs800000. The total saving due to above is 1347840.00 and pay back period is 0.59 years.

(d) This case study is related to rolling mills .The steels ingots are rolled to sheets .



The hot rolled steel coils are slit into required size and then after that warm hydrochloric acid is used for cleaning rolled sheets to remove dirt and dust.Heat treatment process is completed with combination of heating and annealing bases. The furnaces under study are LPG fired. In the heat treatment and annealing process, the general temperature of heating is kept in the range of 740-850 ^{o}C. Then furnace cooling at 600 ^{o}C, the annealing process has lot of heat rejection, The temperature of the job reduces from highest around 600 ^{o}C to room temperature. This heat can be utilized for LPG preheating which is presently heated up to 40^{o}C by use of 10KW electrical heater. This arrange may require to shift the LPG station near chimney and from there the preheated LPG can led to required place. Only part of flue Gas can be used to preheat the LPG and part of the flue gas can be used to heat the seal cooling return water for use in Hydrochloric acid pre heating. This will stop the requirement of boiler which other wise requires 210 liters of HSD per day for Hydrochloric acid warming. Alternatively the HCL can directly be heated with flue gas. This will further reduce the use of pump and piping and requirement of heat exchanger will be one as shown in above diagram.
Thus the estimated saving such type of Industries with above arrangement will be 10KW in electrical heater of LPG, resulting in 37440.00 units of electrical savings @ 12 hrs and 6day/week of effective running which is equivalent to Rs 268211.77. With capital Investment of Rs 300000 the payback period is 6.7 Months.

II. CONCLUSION

The above illustrations are some of the possible uses of low Temperature waste heat in typical Indian Industries . These studied are based on the presumption that uses are in-house and these require minimum Investment. Detailed techno Economic Evaluation of these potentials for adaptation in particular Industry of same segment needs to done before final conclusion for Implementation of any of suggestions in particular establishment.

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