Therefore, steam pressure is reduced upto certain limit, according to process heating requirement without sacrificing either on production time or on the volume of steam consumption.

3. **Proper insulation of steam distribution pipelines**. In steam pipelines, heat is lost due to convection and radiation. Insulation is done by Glass wool, Rock wool and Asbestos. Thickness of insulation should be economic and insulation should be detachable, easily removable when necessary.

4. **By avoiding steam leakage.** Steam leakage must be stopped, it increases the cost of production. It has been calculated that a3 mm diameter hole on a steam distribution pipeline having 7kg/cm^2 steam would waste approx 33 kl of fuel oil per year. Steam pressure plays important role in leakage, steam pressure is directly proportional to the steam leakage.

5. **Proper selection and maintenance of steam traps**. Steam trap is used to distinguish between condensate and live steam. It opens to discharge condensate and closes to trap steam. Steam trap senses the condensate and live steam accordingly opens and closes. The difference between condensate and steam is sensed by

(*a*) difference in density
(*b*) difference in temperature
(*c*) difference in flow characteristics.

Proper selection and maintenance of steam traps avoid unsatisfactory condensate removal and improve plant output. The selection of a steam trap for a particular application depends on the process requirement like temperature, pressure, quantity of condensate and cost effectiveness, etc.

6. **Condensate recovery.** Condensate means when steam gives off its latent heat during process heating, it converts into liquid condense form. Condensate contains remarkable quantity of total heat. If condensate is recovered properly and returned to the boiler house or utilised elsewhere for process heating, it helps in fuel saving.

For every 6°C rise in the feed water temperature by condensate recovery approximately 1% saving in fuel input to the boiler is achieved.

7.12. CONSERVATION IN STEAM TURBINE

Steam turbine is a mechanical device that extracts thermal energy from high pressurized steam and converts it into rotary motion, used in a power plant.

About 80% of all electricity generation in the world is by use of steam turbine.

In large process industries, steam turbines are the main energy consumers. Energy saving can be achieved by maintaining appropriate operating condition. Turbines are designed for a particular operating conditions like steam inlet pressure, steam inlet temperature, turbine exhaust pressure and turbine exhaust vacuum which affects the performance of the steam turbine in a remarkable manner. If operating condition varies,

it affects the steam consumption in the turbine and turbine efficiency too. Turbine efficiency is theoretically calculated as work done by the turbine to the heat supplied to generate the steam. Following factors should be monitored to improve turbines efficiency.

(a) Effect of Steam inlet pressure. For obtaining the designed performance, steam inlet pressure should be maintained at designed level. At low steam inlet pressure. Steam consumption in the turbine increases and turbine efficiency reduces. Similarly if steam inlet pressure is increased, energy available to run the turbine will be high and steam consumption in the turbine is reduced.

(b) Effect of steam inlet temperature. Enthalpy of steam is a function of temperature and pressure. Lowering the temperature, enthalpy goes down, work done by the turbine will be reduced and then steam consumption for the required output will be higher, finally turbine efficiency will be reduced.

On the other side, at higher steam inlet temperature, heat extraction by the turbine will be higher and for the required output, steam consumption will reduce.

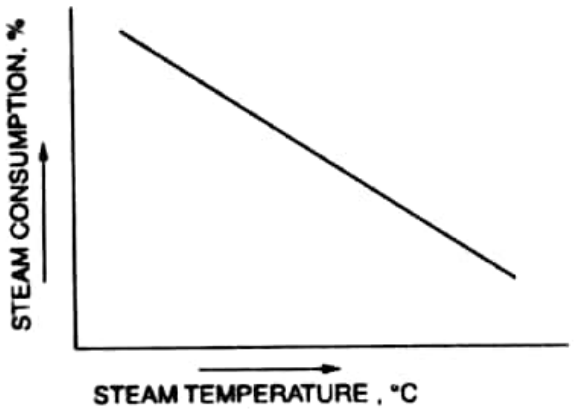

Fig. 7.17. Effect of Steam temperature on steam consumption.

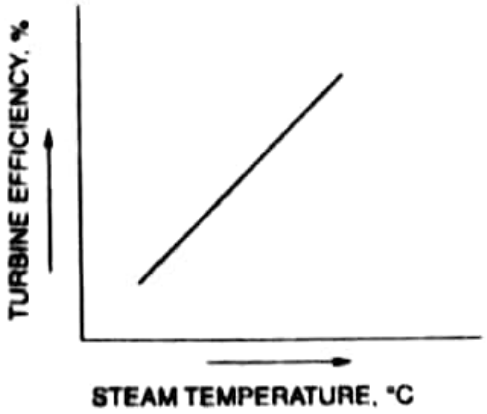

Fig. 7.18. Effect of Steam temperature on turbine efficiency.

(c) Effect of exhaust pressure. Higher exhaust pressure, increases the steam consumption in turbine system, on the other side if exhaust pressure is reduced than the specified, will reduce the steam consumption and improve the turbine efficiency.

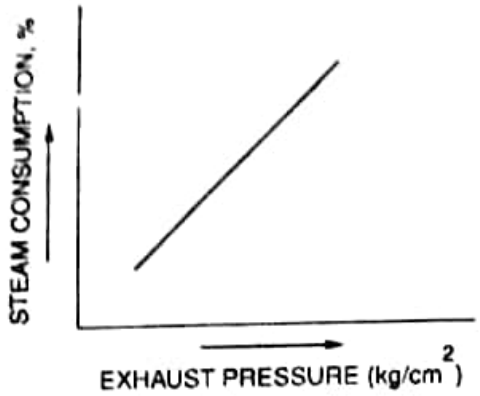

Fig. 7.19. Effect of exhaust pressure on steam consumption.

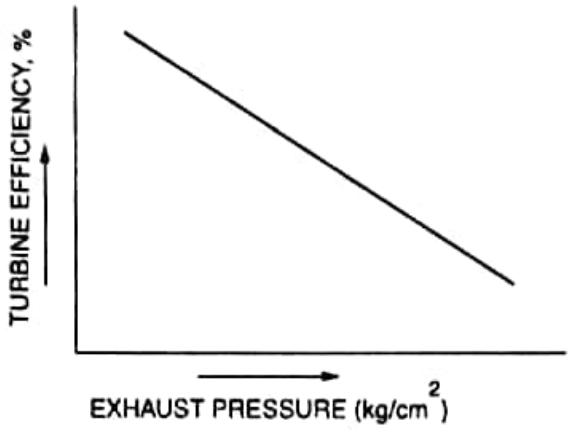

Fig. 7.19. Effect of exhaust pressure on turbine efficiency.

SOLVED QUESTIONS

Q.1. *Write important tips for energy conservation in furnaces.*

Ans. Tips for energy conservation in furnaces are as follows :

1. Use of doors, air curtains and door openings should be minimised.
2. Check against flue gases ($O_2/CO_2/CO$) and excess air
3. Proper select and maintain the burners. Replace oversized, inefficient furnace.
4. Ensure optimum capacity utilisation, control of draught, minimum heat losses, production schedule to operate at maximum effeciency, full load is most important.
5. Ensure that heat distribution is proper, flame does not touch the stock.
6. Ensure that temperature controllers are working accurately and provide proper insulation so that outside surface temperature can be maintained around 50°C
7. Ensure that the furnace combustion chamber is under slight positive pressure and air infiltration is controlled.
8. Improve efficiency by using waste heat recovery device.
9. Evaluate alternate fuels like gas.
10. Jigs and fixtures should be avoided.
11. Furnace should run continuously and avoid part load operation. Charging method should be optimised.