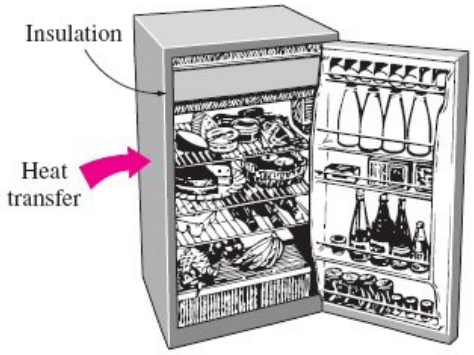
HEAT TRANSFER

INSULATION

Reasons for Insulating

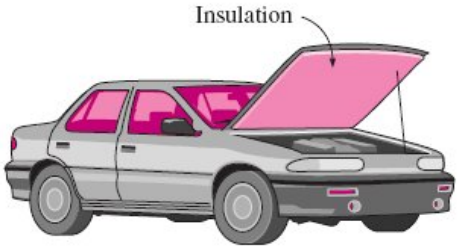
1. **Energy conservation.**
   Conserving energy by reducing the rate of heat flow is the primary reason for insulating surfaces.



The insulation layers in the walls of a refrigerator reduce the amount of heat flow into the refrigerator and thus the running time of the refrigerator, saving electricity.

2. **Personnel Protection and Comfort**
   A surface that is too hot poses a danger to people who are working in that area of accidentally touching the hot surface and burning themselves. To prevent this danger and to comply with the OSHA (Occupational Safety and Health Administration) standards, the temperatures of hot surfaces should be reduced to below 60°C by insulating them.

   Also, the excessive heat coming off the hot surfaces creates an unpleasant environment in which to work, which adversely affects the performance or productivity of the workers, especially in summer months.



The hood of the engine compartment of a car is insulated to reduce its temperature and to protect people from burning themselves.

3. **Maintaining Process Temperature**
   Some process in chemical industry are temperature sensitive, and it is necessary to insulate the process tanks and pipes to maintain the same temperature through out.

4. **Reducing Temperature Variation and Fluctuations**
   The temperature in an enclosure may vary greatly between the midsection and the edges if the enclosure is not insulated. Also, if not insulated the temperature in an enclosure may follow the temperature changes in the environment closely and fluctuate.

5. **Condensation and Corrosion Prevention**
   Water vapor in the air condenses on surfaces whose temperature is below the dew point, and the outer surfaces of the tanks or pipes that contain a cold fluid frequently fall below the dew-point temperature unless they have adequate insulation. The liquid water on exposed surfaces of the metal tanks or pipes may promote corrosion as well as algae growth.

6. **Fire Protection**
   Damage during a fire can be minimized by keeping valuable combustibles in a safety box that is well insulated. Insulation may lower the rate of heat flow to such levels that the temperature in the box never rises to unsafe levels during fire.

7. **Freezing Protection**
   Prolonged exposure to subfreezing temperatures may cause water in pipes or storage vessels to freeze and burst as a result of heat transfer from the water to the cold ambient. The bursting of pipes as a result of freezing can cause considerable damage. Adequate insulation will slow down the heat loss from the water and prevent freezing during limited exposure to subfreezing temperatures

8. **Reducing Noise and Vibration**
   An added benefit of thermal insulation is its ability to dampen noise and vibrations. The insulation materials differ in their ability to reduce noise and vibration, and the proper kind can be selected if noise reduction is an important consideration.

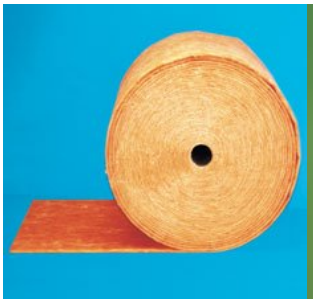
Classification of Thermal Insulation

1. **Cellular Insulation** is composed of small individual cells separated from each other. The cellular material may be glass or foamed plastic such as polystyrene (closed cell), polyurethane, polyisocyanurate, plyolefin, and elastomeric.

Polyurethane insulation

Elastomeric insulation

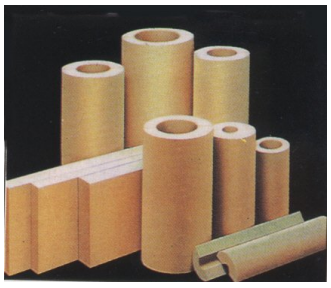
2. **Fibrous Insulation** is composed of small diameter fibers which finely divide the air space. The fibers may be perpendicular or horizontal to the surface being insulated, and they may or may not be bonded together. Silica, rock wool, slag wool and alumina silica fibers are types of fibrous insulation, the more widely used insulation of this type is glass fiber and mineral wool.


Glass fibres


Mineral fibre

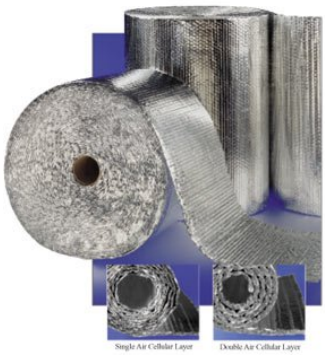

Mineral fibre

3. **Granular Insulation** is composed of small nodules which contain voids or hollow spaces. It is not considered a true cellular material since gas can be transferred between the individual spaces. This type may be produced as a loose or pourable material, or combined with a binder and fibers to make a rigid insulation. Examples of these insulations are calcium silicate, expanded vermiculite, perlite, cellulose, diatomaceous earth and expanded polystyrene.


Calcium silicate insulation


Perlite insulation

4. **Reflective insulation** is based on reflecting the thermal radiation incident on the surface back by using highly reflective surfaces. Reflective insulation can be used by itself to minimize heat flow by radiation or it can be used as a covering on the exposed surfaces or resistive insulations to combat both radiation and conduction



Forms of insulation

Insulation is produced in a variety of forms suitable for specific functions and applications. The combined form and type of insulation determine its proper method of installation. The forms most widely used are:

1. **Rigid boards, blocks, sheets, and pre-formed shapes such as pipe insulation, curved segment, lagging, etc.**: Cellular, granular, and fibrous insulations are produced in these forms.

2. **Flexible sheets and pre-formed shapes:** Cellular and fibrous insulations are produced in these forms.

3. **Flexible blankets**: Fibrous insulations are produced in flexible blankets.

4. **Cements (insulating and finishing):** Produced from fibrous and granular insulations and cement, they may be of the hydraulic setting or air drying type.

5. **Foam:** Poured or froth foam used to fill irregular areas and voids. Spray used for flat surfaces.