

BEYOND

SMART CITIES



BUILDING ENVELOPE CEM REFRESHER

ONLINE TRAINING COURSE

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM





BEYOND

SMART CITIES

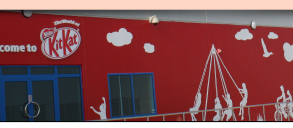


BUILDING INSULATION

FOR ENERGY PROFESSIONALS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM





WHAT SHOULD YOU LEARN



Insulation-types and application

Economic thickness of insulation,

Heat savings and application criteria,



BUILDING INSULATION

A thermal insulator is a poor conductor of heat and has a low thermal conductivity. Insulation is used in buildings and in manufacturing processes to prevent heat loss or heat gain. Although its primary purpose is an economic one, it also provides more accurate control of process temperatures and protection of personnel. It prevents condensation on cold surfaces and the resulting corrosion.

Such materials are porous, containing large number of dormant air cells. Thermal insulation delivers the following benefits:

- ✓ Reduces over-all energy consumption
- ✓ Offers better process control by maintaining process temperature.
- ✓ Prevents corrosion by keeping the exposed surface of a refrigerated system above dew point
- ✓ Provides fire protection to equipment
- ✓ Absorbs vibration



TYPES AND APPLICATION

The Insulation can be classified into three groups according to the temperature ranges for which they are used.

Low Temperature Insulations (up to 90 °C) :

This range covers insulating materials for refrigerators, cold and hot water systems, storage tanks, etc. The commonly used materials are Cork, Wood, 85% magnesia, Mineral Fibers, Polyurethane and expanded Polystyrene, etc.

Medium Temperature Insulations (90 – 325 °C) :

Insulators in this range are used in low temperature, heating and steam raising equipment, steam lines, flue ducts etc. The types of materials used in this temperatures range include 85% Magnesia, Asbestos, Calcium Silicate and Mineral Fibers etc.



TYPES AND APPLICATION +

High Temperature Insulations (325 °C – above) :

Typical uses of such materials are super heated steam system, oven dryer and furnaces etc. The most extensively used materials in this range are Asbestos, Calcium Silicate, Mineral Fibre, Mica and Vermiculite based insulation, Fireclay or Silica based insulation and Ceramic Fibre.



SIMPLIFIED FORMULA FOR HEAT LOSS CALCULATION

$S = [10 \times (T_s - T_a) / 20] \times (T_s - T_a)$
Where
 S = Surface heat loss in kCal/hr m²
 T_s = Hot surface temperature in °C
 T_a = Ambient temperature in °C

Total heat loss/hr (Hs) = $S \times A$
Where A is the surface area in m²

Based on the cost of heat energy, the quantification of heat loss in Rs. can be worked out as under:

Equivalent fuel loss (Hf) (kg/Yr) = $\frac{Hs \times \text{Yearly hours of operation}}{GCV \times \eta_b}$

Annual heat loss in monetary terms (Rs.) = $Hf \times \text{Fuel cost (Rs./kg)}$
Where
GCV = Gross Calorific value of fuel kCal/kg
 η_b = Boiler efficiency in %

Various charts, graphs and references are available for heat loss computation. The surface heat loss can be computed with the help of a simple relation as given below. This equation can be used up to 200 °C surface temperature. Factors like wind velocities, conductivity of insulating material etc has not been considered in the equation.

CASE EXAMPLES

Steam pipeline 100 mm diameter is not insulated for 100 metre length supplying steam at 10 kg/cm² to the equipment. Find out the fuel savings if it is properly insulated with 65 mm insulating material.

Assumptions:

Boiler efficiency = 80%
Fuel Oil cost = Rs.15000/tonne
Surface temperature without insulation = 170 °C
Surface temperature after insulation = 65 °C
Ambient temperature = 25 °C

Existing Heat Loss:
 $S = [10 \times (T_s - T_a) / 20] \times (T_s - T_a)$
 $T_s = 170$ °C
 $T_a = 25$ °C
 $S = [10 \times (170 - 25) / 20] \times (170 - 25) = 2500$ kCal/hr-m²
 $S_1 = S$ = Existing heat loss (2500 kCal/hr-m²)

Modified System:
After insulating with 65 mm glass wool with aluminum cladding the hot face temperature will be 65 °C.

Fuel Savings Calculation

Pipe dimension = ϕ 100 mm & 100 m length
Surface area existing (A1) = $3.14 \times 0.1 \times 100 = 31.4$ m²
Surface area after insulation (A2) = $3.14 \times 0.23 \times 100 = 72.2$ m²
Total heat loss in existing system ($S_1 \times A_1$) = $2500 \times 31.4 = 78500$ kCal/hr
Total heat loss in Modified system ($S_2 \times A_2$) = $480 \times 72.2 = 34656$ kCal/hr
Reduction in heat loss = $78500 - 34656 = 43844$ kCal/hr
No. of hours operation in a year = 8400
Total heat loss Q(Cal/yr) = $43844 \times 8400 = 368289600$
Calorific value of fuel oil = 10300 kCal/kg
Boiler efficiency = 80%
Price of fuel oil = Rs.15000/Tonne
Yearly fuel oil savings = $368289600 / 10300 \times 0.8 = 44695$ kg/year

$T_s = 65$ °C
 $T_a = 25$ °C
Substituting these values
 $S = [10 \times (65 - 25) / 20] \times (65 - 25)$
 $S = 480$ kCal/hr m²
 $S_2 = S$ = Existing heat loss (480 kCal/hr - m²)

BEYOND

SMART CITIES

THANK YOU

THE WORLD'S 1ST GREEN TECHNOLOGY MARKETPLACE

ENERGY MANAGEMENT SPECIALIST

BEYOND SMART CITIES