Best Practice On Insulation Of Process Installations

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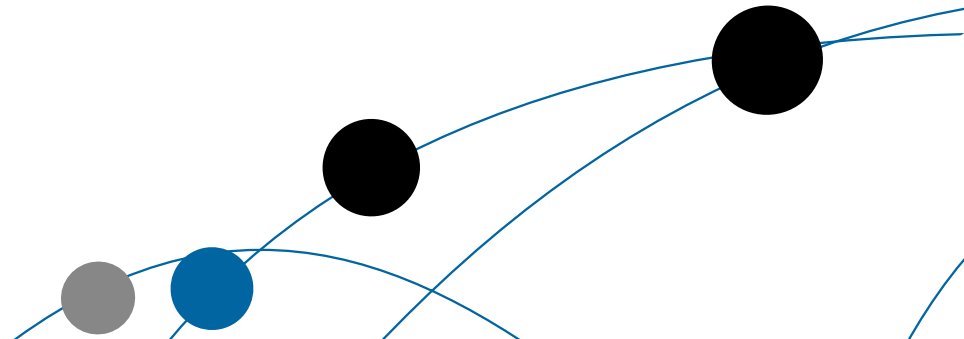
Introduction

To manage a heat flow is becoming increasingly more important. On the one hand cost of energy is increasing and on the other hand higher demands are imposed to control the temperature and to satisfy the safety and environmental requirements.

The problem with heat is that it disappears unnoticed and it is not always easy to detect where the leak is (but nowadays quick scans are a possibility).

Despite the importance of insulation it is often treated as if it is of minor importance. Insulation consists of approximate 3 % of total project costs for new plants. In the maintenance budget the insulation costs may well be up to 5-8 %.

Source: AkzoNobel



General Recommendations

Some examples (with 8500 operating hours per year and a gas price of € 0.30 per m^3) may illustrate the very low pay back times:

- An non insulated outside line of 150 mm with a temperature of 220 °C has an energy loss per year of € 1200 I m and a C02 emission of 7000 kg/m; for an inside line this is € 450 I m. The insulation costs for this line amounts to € 100 I m
- Non insulated valves loose just as much energy as 2 m line length of the same diameter. A valve of 150 mm at 220 °C loses outside € 2400 I year and inside
- € 900 I year . The insulation cost for this valve is approximate € 200. For valves and flanges it is advised to use easy demountable insulation for inspection purposes.

Economical insulation thickness

A lot of factors play a role in the determination of optimal insulation thickness:

- Cost of energy
- Future developments in the price of energy
- Cost of insulation
- Labour costs
- Operating temperature
- Medium
- Complexity of the pipe network
- Operating hours per year
- Future costs of maintenance

Heat loss is not brought back to zero.
For pipe lines the loss reduction is about 90-95 %.
For auxiliaries this amounts to 80-85%.

For a simplified diagram see figure 1.
For a worked example See table 1.

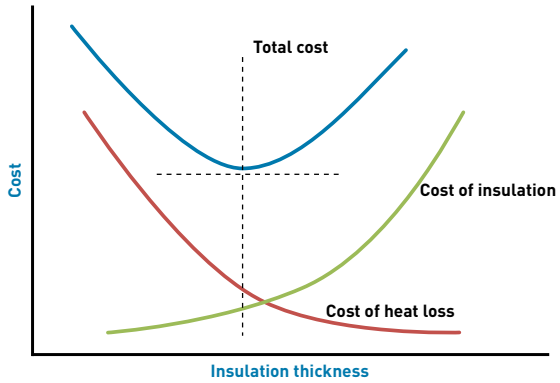
Starting points for the calculations were:

- Pipe diameter 100 mm, Process Temp 250 °C, Ambient Temp. 10 °C.
- Energy cost 8 € /GJ, operating hours per year: 8500.
- Reference year: 2009
- Depreciation period: 7 years

Tabel 1: Example economical insulation thickness calculation

Insulation Thickness (mm)	Heat loss (W / m)	Energy loss (GJ / year / m)	Energy costs (€ I m /year)	Insulation costs (€ I m I year)	Total costs (€ / m)
50	100	3.06	24.48	10.43	34.91
100	73	2.23	17.84	16.00	33.84
200	51	1.56	12.48	32.57	45.05

Figure 1: Economical insulation thickness



Design of insulation systems

There are two important physical effects with insulation:

- Reduction of temperature differences by heat flow. This may be heat insulation or cold insulation.
- Together with heat flow also transport of water vapor occurs.

There is an essential difference between the two:
With cold insulation the heat flow but also the water vapor flow must be blocked.
With heat insulation the necessity for blocking the water vapor flow is not present; only (rain) water must be prevented to seep in.
The heat conductivity of insulating material varies in the range 0.02-0 .05 W Im.K (at 20°C) .The heat conductivity of water is 0.55 W/m.K. It is evident that accumulation of moisture in the insulating material will cause a marked reduction in insulation; 1 % moisture may drop the insulation value to 50%!
Moreover moisture is one of the main causes of corrosion under the insulating material.

CINI is the name for “Commissie Isolatie Nederlandse Industrie”. This committee has published a “Handbook for Insulation” and at the moment are updating their program called “Thermal Insulation Calculation Program” to do the calculations for economical thickness.
See:
https://www.cini.nl/en/knowledge-center/cini-webshop/

Assembly of the insulation

Correct assembly of the insulation is a key factor in good functioning of the insulation. This is particularly true for cold insulation in view of the vapor barrier layers. Engineering firms usually have extensive specifications regarding the execution of the assembly. The work is carried out by specialized firms.

Important aspects

- **# Quality**

  It can not be stressed enough that quality of the design and assembly are very important in getting good results from insulation.

- **# Maintenance**

  Insulating materials are relatively soft and also the sheeting is vulnerable. That is why inspection and maintenance have to be done on a regular basis. To prevent damage instructions must be given to all plant personnel that standing I walking on insulation is not permitted. It is also wise not to have fire drills in areas with a lot of insulation. After a leak has been detected and repaired the insulation must be put back on asap. When longer length of (old) insulation was removed for maintenance or revamp it is advised to check whether the economic insulation thickness still applies or a thicker layer is more economic in view of higher energy costs.

- **# Corrosion under insulation**

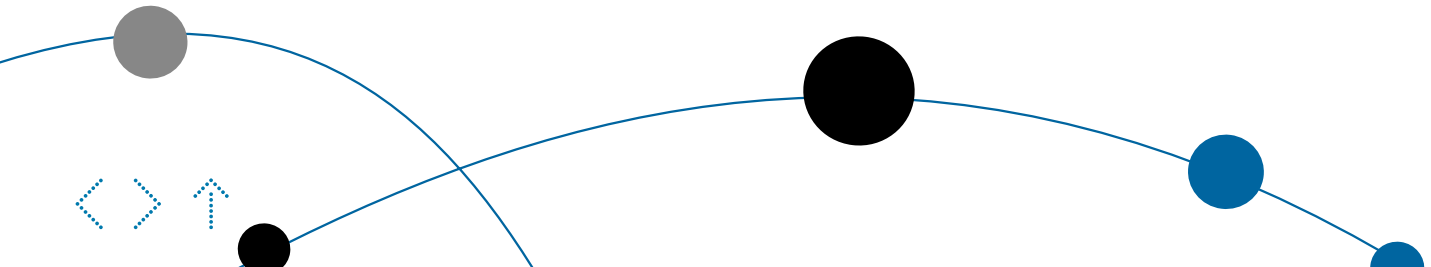
  It is now accepted by many that surfaces to be insulated get a good conservation (protective layer). For most systems the inspection interval may be prolonged in that case.
  Corrosion under insulation is a rather tricky phenomenon. Especially lines and equip ment in the temperature range - 10 I + 120 °C are susceptible but also intermittent systems. Also stainless steel may be subject to corrosion under certain circumstances.

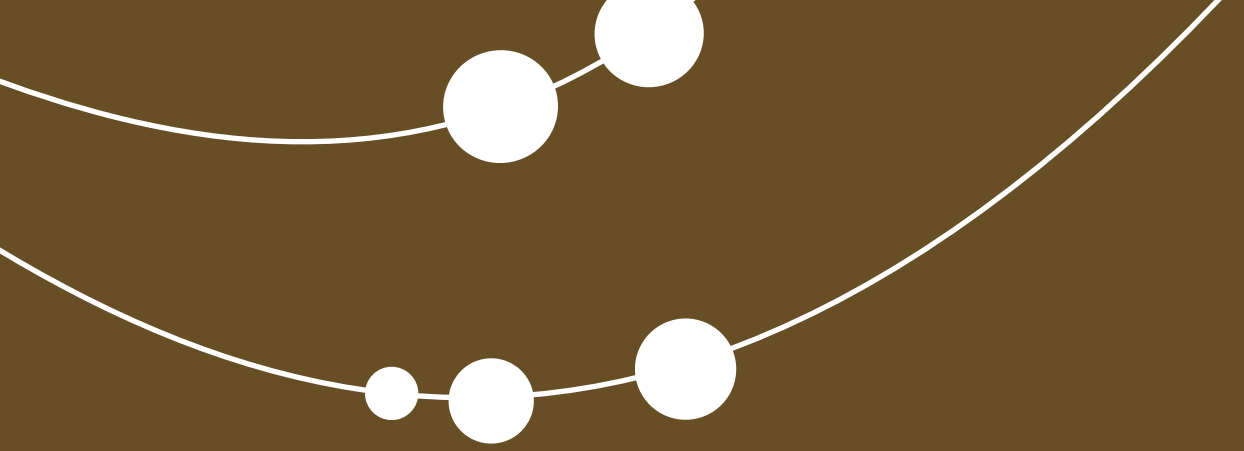
- **# Supports**

  Supports of lines are still a source of heat loss. With hot lines the loss is difficult to detect. With cold lines it is easier because the support will show condensation or ice formation.

- **# Detection of heat losses**

  In real practice by:
  - Inspection I check on damage of sheeting
  - Check by hand whether insulation is warmer than normal; this would indicate water presence
  - Inspection with IR camera's by specialized firms.





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Source: AkzoNobel