TIPCHECKs offer rapid payback times and great energy savings potentials

Andreas Gürtler
Foundation Director
European Industrial Insulation Foundation
Avenue du Mont-Blanc 33
CH-1196 Gland
Switzerland
andreas.guertler@eiif.org

Pascal Decker
President
European Industrial Insulation Foundation
Avenue du Mont-Blanc 33
CH-1196 Gland
Switzerland
info@eiif.org

Keywords

training, waste heat, thermal insulation, solutions, measurement and evaluation, insulation, savings potential, reduced pay-back time, reduced cost, industrial energy saving, evaluation methods, energy-intensive industry

Abstract

Industrial Insulation is a proven best available technique for energy efficiency but its benefits are very often overseen. Industry tends to see insulation rather as a necessary evil, than as a cost-effective investment to save energy and money and cut emissions.

With energy prices expected to continue to rise, becoming energy efficient is gathering more importance than ever. Strangely enough, records show that insulation in industry is far below cost-effective levels, even with today's prices; many parts of installations remain un-insulated, and maintenance seems in some cases non-existent. The cause of this is mostly due to a lack of awareness and know-how.

To this end, the European Industrial Insulation Foundation (EiiF) created an insulation energy appraisal programme for industrial insulation called TIPCHECK. The name stands for Technical Insulation Performance Check. TIPCHECKs are European wide standardised insulation energy appraisals of industrial installations identifying spots like un-insulated pipes or valves, vessels or flanges offering great energy savings potentials if insulated.

EiiF certifies in its TIPCHECK trainings experienced and highly qualified insulation engineers to TIPCHECK engineers. With the first engineers having been certified, EiiF is receiving clear reports which show the great potential of industrial insulation in European industry. Furthermore the first case studies show that this potential would be even greater if TIPCHECK engineers would be involved in the planning process of major overhaul, retrofit or new-build projects.

The EiiF presentation at eceee will be illustrated with these interesting first case studies and explain in detail the reasons, why in industry insulation offers rapid payback times of most often one year or even less and therefore is a highly attractive and first step to increase the energy efficiency of industrial processes.

The European Industrial Insulation Foundation is a European non-profit foundation registered in Switzerland. It has been set up to promote and establish the use of industrial insulation as a widely understood and accepted means of achieving sustainability. Since its foundation EiiF has established itself as a resource for industries that need to reduce CO_2 emissions and save energy.

Introduction

With energy prices expected to continue to rise, becoming energy efficient is gathering more importance than ever. Strangely enough, records show that insulation in industry is far below cost-effective levels, even with today's prices. In many cases, the cause for this is a lack of awareness or knowledge. The European Industrial Insulation Foundation (EiiF) commissioned the Dutch consultancy agency Ecofys to investigate the size of the potential savings from unnecessary heat loss in EU27. The results of that study are also presented during these Summer Studies in Panel 4.

From this study, we know that a savings potential exists in almost every industrial installation. Unfortunately, this potential is very specific from case to case. Every plant is a completely different complex system, even within the same sector

or corporation. For this purpose, the EiiF created a training programme for expert engineers in industrial insulation. The programme was appropriately named TIPCHECK. The name stands for Technical Insulation Performance Check. TIPCHECK engineers go into each individual plant and offer their client an independent energy audit report on the state of the insulation of their plant and with recommendations on how to improve it.

Why do energy audits

Industrial insulation experts observe that in many cases, thermal insulation in industry is poorly maintained and that some parts remain un-insulated creating thermal bridges that result in excessive heat losses. They also note that the level of insulation applied is typically based on requirements regarding the maximum surface temperature that equipment is allowed to reach to avoid personal injuries or based on generic maximum heat loss rates allowed, rather than cost-effective or energy-efficient solutions. There are usually several reasons for companies not to make detailed assessments of the cost-effectiveness of insulation and not to maintain existing insulation:

- There may be a general lack of information for the main decision makers about the large energy savings potential of industrial insulation.
- Insulation is a relatively small part of investments. Even though poor insulation leads to higher costs of heat loss over many years, it is often seen as less important.
- Retrofitting insulation can, or can be perceived to, cause disruption in production.
- In common with other energy efficiency measures, it is not the core business of the main decision makers.
- There may be a lack of information about improvements in insulation materials and in the design of modern insulation systems.
- Split or unclear responsibility for decisions on maintenance and/or installation of insulation.

The additional investment needed for good insulation (in comparison with current insulation levels) tends to be controlled by the maintenance manager. The savings that are realised by this create decreased costs in the energy budget, which tends to be controlled by a different department. To bring these two together requires a decision on a higher management level, where unfortunately even less awareness of the technology and potential benefits of insulation exists.

The TIPCHECK Programme

TIPCHECK provides clients with an independent report on the state of their insulation. TIPCHECK also provides engineers with a certification of skill and quality. It creates a platform for these professionals to exchange information and knowledge on the state of insulation and its technology.

TIPCHECK is not intended to be a full system analysis. However, it always tends to identify the spots bearing the highest energy saving potential and offering a rapid payback time of not more than 1–2 years. The TIPCHECK report shows its client how a facility could save energy, improve process control and efficiency, contribute to a cleaner environment due to reduced emissions, save money and reduce safety risks to personnel and equipment.

TIPCHECK is a seal of quality and a standardized method to evaluate the technical insulation performance of industrial insulation. TIPCHECK engineers must pass high standards of qualification. Their work is checked by a neutral foundation, whose sole intention and purpose (article 2 of the EiiF Statutes, 2009) is to reduce the consumption of energy and related emissions in industry.

TIPCHECK is a tool to quantify the amount of energy and actual euros a facility is losing in its current configuration. With a TIPCHECK certification, engineers are able to deliver an independent report on a client's installation.

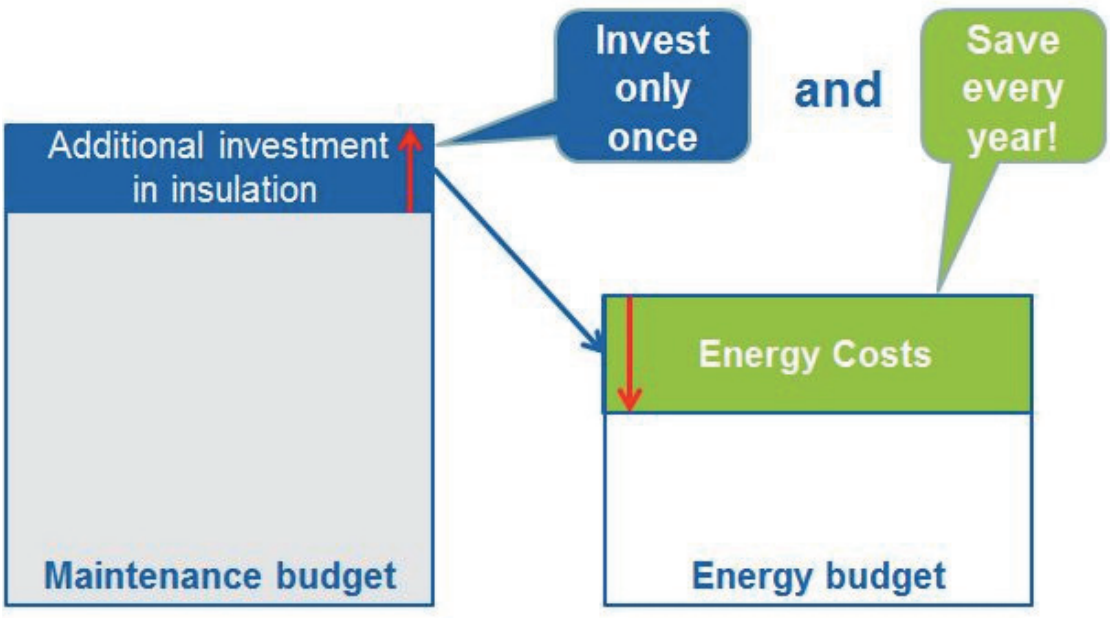

Figure 1: Split responsibilities.

TRAINING

As the EiiF is an open, independent foundation, its membership programme is open to anyone connected to industrial insulation. Any engineer may sign up for TIPCHECK training, though some requirements exist in order to maintain the quality of the programme (EiiF 2012). A candidate for TIPCHECK training must pass following criteria:

1. Need to be an employee of an EiiF Partner or Member with an installed ISO 9001 QM-system;
2. Need to have at least 4 years of experience in insulation projects in the industrial environment;
3. Need to be able to calculate and design industrial insulation systems;
4. Must be holder of a Master Degree in engineering (or similar);
5. Shall agree to and sign the TIPCHECK guidelines as issued by EiiF.

To this day, more than 30 engineers from 10 different countries have successfully passed the training and are active in assessing the insulation of industrial plants.

Engineers follow regular refresher courses to keep their knowledge up-to-date with the latest developments in the technology.

AUDITING

In most cases, TIPCHECK engineers carry out TIPCHECKs in the name of the EiiF Partner or Member company they are employed with. If clients ask for it, TIPCHECKs can also be carried out directly by EiiF.

The main role of EiiF in any TIPCHECK is the control of quality and neutrality throughout the work. For this reason, engineers are required to follow the TIPCHECK guidelines and to follow regular refresher courses. The engineers are randomly checked during their TIPCHECK activities. Anonymous results from TIPCHECKs are collected in the annual EiiF TIPCHECK report.

Case Studies

In every executed TIPCHECK, saving potentials are found. Most often, the potentials can be realised immediately and with payback times of less than one year. Also, issues such as safety risks to personnel or fire risks are detected often.

CHEMICAL PLANT, FRANCE

An insulation energy audit was performed on a refinery in France by one of the EiiF Founding Partner companies. The auditing consisted of one employee, spending two weeks on-site and taking over 400 thermal images for the final audit report. These were the most important findings:

1. Safety

Situations were located where a high risk of burn damage exists to the personnel. In figure 22 the thermographic picture shows a dangerously hot surface temperature of more than 138 °C on a boiler window, situated right next to a ladder support.

Secondly, about 30 un-insulated valves were found that not only pose a severe burn risk for personnel, but also cause a large loss of energy. Instalment of matrass insulation on these parts ensures temperatures of below 50 °C, which is safe to be handled by personnel wearing gloves.

2a. Energy efficiency & environment – valves

Detected energy loss on each valve:
Internal temperature: 300 °C
Unnecessary energy loss per hour: 2.3 kW/m²*h
Unnecessary energy loss per year (availability 8,760 h):
approx. 20,000 kWh

Total saving potential for valves:
30 valves * 20,000 kW = 600,000 kWh/a

2b. Energy efficiency & environment – tanks

Also, 35 Storage tanks were found with un-insulated rooftops. The surface of these is about 28 m²/tank. The temperature of liquids stored inside being 150 °C, this gives the following results:

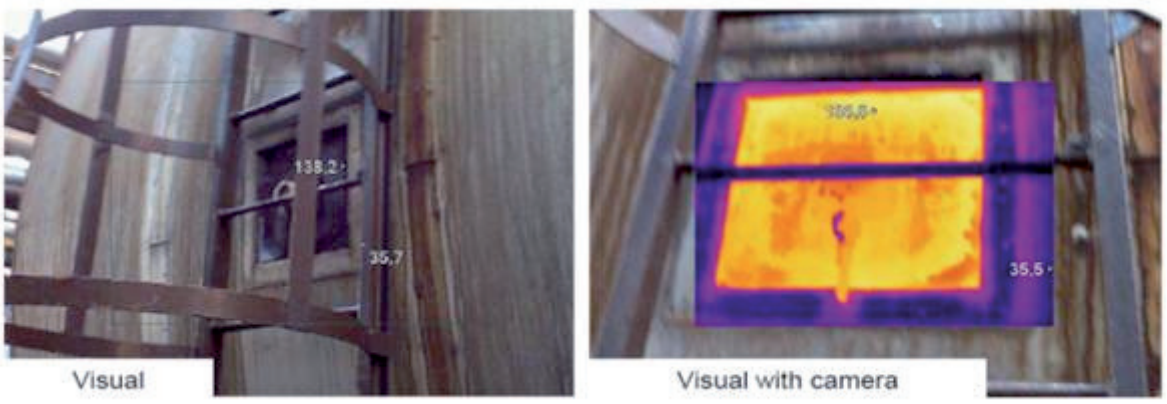

Figure 2: Regular and thermographic photo of a boiler window with severe risk of burning for personnel.

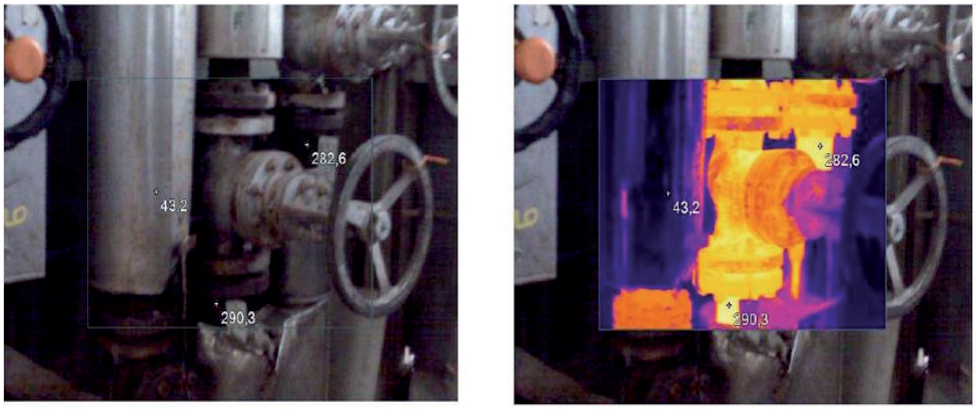

Figure 3: Regular and thermographic photo of an un-insulated valve.

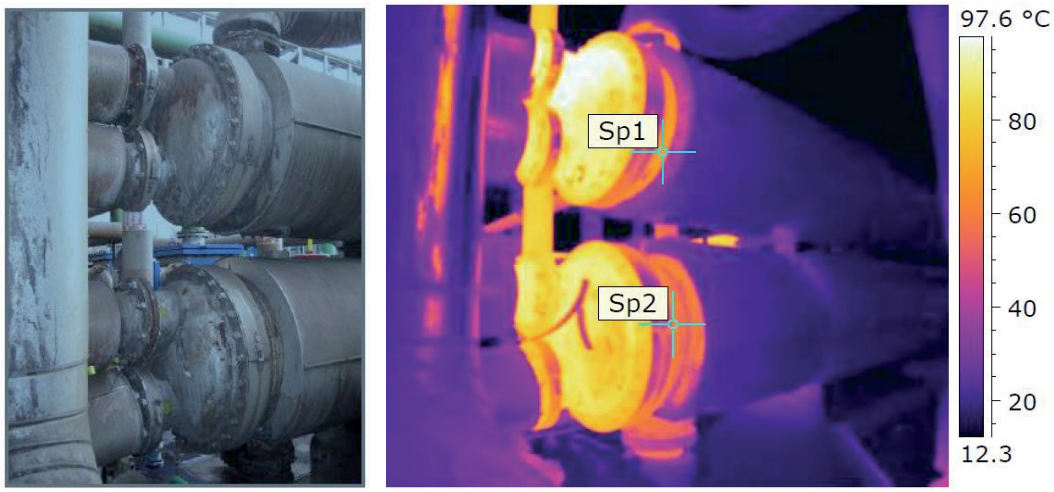

Figure 4: Regular and thermographic photo showing dangerously high temperature surfaces.

Saving potential per tank:
Internal temperature: 150 °C
Unnecessary energy loss per hour: 1.4 kW/m²*h
Unnecessary energy loss per year (availability 8,760 h/a):
approx. 343.4 MWh

Total saving potential for rooftops:
Rooftops of 35 tanks: approx. 12,000 MWh/a

3. Financial Gains

Total unnecessary annual energy loss: approx. 12,600,000 kWh/a
Total annual financial potential (4ct/kWh):
approx. 505,000,– EUR/a

Investment:
TIPCHECK: approx. 10,000,– EUR
Insulation instalment and material costs: approx. 90,000,– EUR
Total investment: approx. 100,000,– EUR

Realised until today:
Investment costs: approx. 100,000,– EUR
Savings moneywise first year: approx. 405,000,– EUR
Savings moneywise following years:
approx. 505,000,– EUR/a

Payback time:
Time until investment is paid back (energy cost only):
approx. 2.4 months

CHEMICAL PLANT, THE NETHERLANDS

The possible gains from insulating valves and other un-insulated elements of a plant that needed to remain in operation, was investigated by another EiiF Founding Partner company. The TIPCHECK engineers measured temperature losses of about 80 objects in 37 different positions along the production line.

In this particular case, the client requested the insulation to be improved up to his own standards. This level is most likely lower than the cost-effective level (as described by Ecofys 2012). As such, a higher savings potential could have been achieved if the cost-effective or energy-efficient level of insulation was applied.

Calculated saving potential:
Annual savings: 28,361 EUR/a, 1,500 MWh/a, 5,424 GJ/a
Calculated instalment cost: 18,844 EUR
Calculated saving in year of investment: 9,517 EUR
Calculated saving in following years: 28,361 EUR/a
Annual savings (according to plant owner): 28,651 EUR/a
Payback time: 8 months

Figure 5: Pumps break down.

Figure 6: Valves can no longer be operated.

Figure 7: The control panel needed to be protected with plastic sheeting from the dripping condensation water. Extensive ice building on pipes and valves.

CONDENSATION ON UNINSULATED PARTS

In applications with temperatures below the ambient level insulation has other demands besides limiting the loss of energy. Below are some examples of cases where several problems came up. These problems were caused by either missing insulation on some parts, insufficient insulation (causing dew point problems) or damaged vapour barriers and/or insulation.

Water vapour is always present in the air. When this vapour comes close to colder surfaces it condensates. This condensation could happen either on uninsulated parts, or inside the insulation layer. A good vapour barrier outside the insulation layer is therefore important.

If condensation is allowed to happen, the water (or ice) will:

- Increase energy losses
  - Water has a 20x higher thermal conductivity than air
  - Ice has a 100x higher thermal conductivity than air
- Cause damage to the insulation material
- Cause corrosion to pipes, vessels & cladding
- Cause structural problems for the installation (due to the extra weight)
- Cause inoperable valves, engines, pumps (ice build-up)
- Cause electrical shortcuts, make control panels brake down

Figure 8: Broken vapour barriers and insufficient insulation caused ice to form around these pipes causing both process control problems and structural problems.

Cold insulations have in general a limited life expectancy: They are unstable systems, which for physical reasons react sensitively to damages. They must be maintained regularly, which includes a routine check of seals and interruptions. This is needed not only to save decent volumes of energy but also to keep industrial processes running.

Conclusion

Economically speaking, the need for energy efficiency is increasing with the cost of energy climbing and other resulting costs such as CO_2 certificates (through ETS or similar measures). Ecologically the same is true. Efforts will be needed to make sure industry reaches the EU's 20-20-20 goals. These goals have been criticized by many as being 'not enough' to limit climate change, nor will they be enough to counter the expected rise of energy prices.

Studies show that a large potential to save energy and emissions (and thus money) exists in the application and maintenance of good insulation. Unfortunately, because industrial installations are so complex and vary so much, it is not possible to dictate a simple rule on how much insulation should be used. In order to correctly assess the spots bearing the greatest potential in an operating plant, energy auditing needs to be carried out.

The TIPCHECK Programme delivers independent reports on the state of industrial insulation, and trains insulation experts on energy auditing. This programme was started in 2011, and the results show that a potential exists in almost every installation, with attractive payback times of the insulation investment that are most often less than one year. An additional savings effect could be achieved if insulation experts would be involved in the planning processes of new installations or major retrofits.

References

EC, "EU energy trends to 2030," European Commission, 2009a

EC, "Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries," European Commission, 2009b

ECN, "Transitie naar een duurzame energievoorziening in 2050; Evolutie of Revolutie?" Energieonderzoek Centrum Nederland, October 2002

EiiF, "Climate Protection with rapid payback; Energy and emissions saving potential of industrial insulation in EU27 industry", Ecofys, 2012

EiiF, "Guidelines for TIPCHECK engineers", European Industrial Insulation Foundation, version 12.5, 2012

EiiF, "Statutes of the Foundation", European Industrial Insulation Foundation, 2009

FESI Technical Lexicon, http://cms.fesi-insulation.eu/_private/PDFs/Lexicon/Lexicon.pdf, accessed March 2012

FESI Thermal Technical Document 2 "Guide to good insulation practice", FESI, May 2010

FESI Thermal Technical Document 3 "Code of practice for carrying out thermal insulation work at above and below ambient temperature in the temperature range -80 °C to + 850 °C", FESI, May 2010

KAEFER, 2010, "Optimum insulation layer thickness distribution leads to enhanced profitability," KAEFER Corporate Technology & Research, Technical Information, No. CTR-T 10 101 EN, 2010 (provided by EiiF)

King, R.L., "Mechanical Insulation Maintenance: A Proven Investment Opportunity Hidden in Plain Sight," Insulation Outlook, December 2010

Lettich, M.J., "Insulation Management and Its Value to Industry," Steam Digest, Volume IV, 2003, pp. 27–32

Newell, R.G., Jaffe, A.B. and Stavins, R.N., "The effects of economic and policy incentives on carbon mitigation technologies," Energy Economics, 28, 2006, pp. 563–578

Technischer Brief der BFA Wärme-, Kälte-, Schall- und Brandschutz im Hauptverband der Deutschen Bauindustrie, Nr. 7 "Grundlagen der Kälteisolierung – Principles of cold insulation", Juli 2009, 3rd edition, Deutschen Bauindustrie e.V., Berlin

Technischer Brief der BFA Wärme-, Kälte-, Schall- und Brandschutz im Hauptverband der Deutschen Bauindustrie, Nr. 8 "Auslegung der Kälteisolierung zur Tauwasserverhütung auf der Oberfläche – Design of cold insulation to prevent formation of condensation on the surface", November 2011, 3rd edition, Deutschen Bauindustrie e.V., Berlin

Technischer Brief der BFA Wärme-, Kälte-, Schall- und Brandschutz im Hauptverband der Deutschen Bauindustrie, Nr. 9 "Messverfahren – Methods of measuring", Deutschen Bauindustrie e.V., Berlin

Technischer Brief der BFA Wärme-, Kälte-, Schall- und Brandschutz im Hauptverband der Deutschen Bauindustrie, Nr. 14 "Energieeffizienz im Anlagenbau– Energy efficiency in plant construction", November 2011, 2nd edition, Deutschen Bauindustrie e.V., Berlin

VDI, "Thermal insulation of heated and refrigerated operational installations in the industry and the building services; Calculation rules," VDI 2055, Verein Deutscher Ingenieure, September 2008