Insulation, The Forgotten Technology
for
Energy Conservation & Emission Reduction

ST. LOUIS, MISSOURI USA
MAY 31 – JUNE 3, 2009

PaperCon '09
Hot Flashes, Cold Spots & Excess Gas

Insulation, The Forgotten Technology Can Help
Discussion Topics – Learning Objectives:

- The need and value to “Think about Insulation Differently”
- Review evidence of the Power of Insulation
  - Energy Conservation & Efficiency
  - Emission Reduction
  - Job Creation & Preservation
- Understanding the risk of not maintaining an insulation system
- How to qualify and quantify the value of this technology, simply known as insulation and
- Obtain “Mechanical Insulation System” resources
Defining Mechanical Insulation

MECHANICAL INSULATION encompasses all thermal, acoustical, and personnel and life safety requirements in Industrial and Building or Commercial applications:

> Mechanical piping and equipment, hot and cold applications
> Heating, Venting & Air Conditioning (HVAC) applications
> Refrigeration and other low-temperature piping and equipment applications
The Importance of Insulation

Mechanical insulation is the “Rodney Dangerfield” of energy conservation, emission reduction, and many other initiatives!

“No respect” for the potential benefits of mechanical insulation or the potential Return on Investment (ROI)

Mechanical insulation is the “Forgotten Technology”
WHY IS INSULATION, THE FORGOTTEN TECHNOLOGY?

Simple - it is not sexy!

- Reduced knowledge base has led to underutilization and insulation systems being applied but rarely “engineered”
- No gauges
- No monitoring
- No computer chip
- Insulation is normally part of larger mechanical contract

The benefits are instantaneous, but invisible and taken for granted
Putting The Power of Insulation to Work

Have the considerations changed – are they different today than five years ago?

**WHY INSULATE?**

1. *Reduce energy cost*
2. *Reduce polluting emissions*
3. Control condensation, mold & Corrosion Under Insulation (CUI)
4. Provide work place safety and life safety
5. Improve work environment
6. Improve process control
7. Use with sustainable design initiatives
8. Improve facility lifecycle costs
9. Provide exceptional Return on Investment (ROI)
Insulation significantly reduces the energy required to run a facility and its processes.

Remember the past, for it could look like the future. We have been here before—We often forget that.
Did you know?

It has been estimated that between 10% & 30% of all mechanical insulation is missing or damaged!

Petroleum Segment – 21% Chemical Segment – 19%

This same characterization applies to mechanical insulation in nearly all applications, some greater than others.
Oil Refinery Illustrative Example
Heat Loss Analysis

1.87 million lineal feet of insulated pipe, 21% of insulation is missing or damaged, 8” NPS @600 F Operating Temperature with 60 F Ambient Temp. w/ 5 MPH wind and 1 ½ “Mineral Fiber insulation system
**Oil Refinery Illustrative Example**

**Heat Loss Analysis**

The heat loss equates to 5,800 barrels of oil @ $50 per barrel

$290,000 Lost per day

$522,000 @ $90 per barrel

$812,000 @ $140 per barrel

The same principle applies to all mechanical insulation applications !!!

This is a BIG $-Dollar-$ opportunity – you cannot afford to overlook

This is a BIG number
Cut it in half, cut it by 75%
This remains a BIG number

What about the pulp & paper, power & process, petro-chemical, manufacturing industries, etc?
SAVE ENERGY NOW
INDUSTRIAL TECHNOLOGIES PROGRAM

(Individual Facility Published results reviewed July 22, 2008)

- **717 Assessments complete** (January 2, 2009)
- **180 Public Reports Issued**
  - 51% have specifically mentioned insulation
- Total potential annual energy savings & emission reduction for all initiatives
  - $937 Million in energy cost savings
  - 87.2 Trillion BTU natural gas savings
  - 7.9 Million metric tons potential carbon dioxide – CO₂ emissions reduction
SAVE ENERGY NOW
INDUSTRIAL TECHNOLOGIES
PROGRAM
(Published results as of July 1, 2008)

**Insulation References**

Near Term (<1 yr. return) 82%
Medium Term (<3 yr. return) 15%
Long Term (>3 yr. return) 3%

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Missing, damaged, or uninsulated 70%
Upgrade or improve 30%
SAVE ENERGY NOW
NEAR TERM Insulation Initiatives

BAYER (2 Steam Plants), Institute, WV
By improving and replacing missing insulation on the steam and condensate lines – Potential savings $926,000 per year

BOISE CASCADE (Paper Mill), Jackson, AL
By replacing missing pipe insulation – Estimated savings $80,000 per year, cost to complete the work $25,000 = Payback in 3.2 months

MITTAL STEEL, Weirton, WV
Hot water washing tanks are located throughout the facility, 50,000 SF of surface area. The surface temperature of these tanks is 140°F Assuming ½ the heat loss can be saved with an inexpensive – simple insulation system, the annual savings would be $371,000 + per year
Energy conservation with the use of mechanical insulation - “Low Hanging Fruit” - is simply an OPPORTUNITY that should not be overlooked

It is an investment that may have few rivals from a return perspective.

(1) Equivalent energy savings in Millions of Btu/yr (MMBtu/yr) of primary fuel
Insulation reduces plant greenhouse gas emissions by reducing plant energy consumption

\[ \text{CO}_2 - \text{NO}_2 - \text{Carbon Equivalents (CE)} \]

This is a great example of why we need to think about insulation differently.
# Insulation, Is “Greener” than Trees

<table>
<thead>
<tr>
<th>Carbon Reduction Option</th>
<th>Lbs of CO₂ per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ft of insulation on 350°F pipe</td>
<td>2,308</td>
</tr>
<tr>
<td>1 car, 5% increase in mpg</td>
<td>570</td>
</tr>
<tr>
<td>1 compact florescent light bulb</td>
<td>130</td>
</tr>
<tr>
<td>1 ft of insulation on 180°F pipe</td>
<td>109</td>
</tr>
<tr>
<td>1 ft of insulation on 42°F pipe</td>
<td>88</td>
</tr>
<tr>
<td>1 tree</td>
<td>50</td>
</tr>
</tbody>
</table>
Insulation CAN HELP Reduce Polluting Emissions and Increase Available Carbon Credits

There is no question!

The environment and energy conservation efficiency are going to be center stage in the financial and political arenas for years to come

One credit is considered equivalent to one ton of CO₂ emissions
The cost of cutting carbon in different ways
Marginal cost of abatement, examples €/t CO₂

- Water heating
- Cellulosic ethanol
- Nuclear
- Sugar-cane biofuel
- Wind
- Solar
- Forestation
- Carbon capture and storage in retrofitted coal-fired power stations
- Carbon capture and storage with enhanced oil recovery and new coal-fired power stations
- Switch from coal to gas for power generation
- Fuel-efficient vehicles
- Lighting systems
- Fuel-efficient commercial vehicles
- Insulation improvements

Abatement potential, gigatonnes CO₂/year in 2030

Source: Vattenfall
How much energy is being saved, emissions reduced or jobs created or preserved with mechanical insulation?

How Big is the Opportunity?

IT’S BIG!

YET, MECHANICAL INSULATION GETS LITTLE RESPECT!

HOT – COLD – HVAC
IT IS CLEARLY A BIG OPPORTUNITY
What is the scope of the opportunities?
“Show me the numbers”

NIA Objective: Work with Federal, State and local government agencies and industry to answer that question. Working the DOE’s – Industrial Technology Program (ITP) Save Energy Now (SEN) assessments we were able extrapolate data to determine the potential industrial opportunity by industry segment

4,014 Large Plants = >500 BBtu/yr (SEN)  
112,398 Medium Plants = 26 – 500 BBtu/yr (IAC)  
84,298 Small Plants = < 26 BBtu/yr (Not included in the program)

The number of plants were determined from the Energy Information Administration – Manufacturing Energy Consumption 2002 Survey and do NOT include the Power-Utility Industry or the commercial – building sectors
SAVE ENERGY NOW
INDUSTRIAL TECHNOLOGIES
PROGRAM

A Portion of the Industrial – Maintenance Segment

<table>
<thead>
<tr>
<th>Plant Size</th>
<th>Energy Savings Billions ($) /year</th>
<th>CO² Reduction Trillion Lbs/yr</th>
<th>Payback (Months) ROI (*) (20 yrs)</th>
<th>Jobs (*) Created Preserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large/Medium</td>
<td>&gt; $ 1.9</td>
<td>&gt; 45.6</td>
<td>14.8 / 84%</td>
<td>14,874</td>
</tr>
<tr>
<td>Small (*)</td>
<td>&gt; $ 0.6</td>
<td>&gt; 15.9</td>
<td>9.6 / 135%</td>
<td>2,930</td>
</tr>
<tr>
<td>Total</td>
<td>&gt; $ 2.5</td>
<td>&gt; 61.5</td>
<td>13.4 / 107%</td>
<td>17,804</td>
</tr>
<tr>
<td>Distribution (*)</td>
<td></td>
<td></td>
<td></td>
<td>1,342</td>
</tr>
<tr>
<td>Total</td>
<td>&gt; $ 2.5</td>
<td>&gt; 61.5</td>
<td>13.4 / 107%</td>
<td>19,146</td>
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* Estimated by NIA
Many times in less than 1 year and faster than nearly any other energy efficiency investment. That all sounds good, but how can you quantify the savings and return?
3E Plus Insulation Thickness Computer Program

Energy
Environment
Economics

www.pipeinsulation.org

Discs are available or you can download the program
EXAMPLE

Heat Loss – Energy Conservation

• 8” NPS Steel Horizontal Pipe
• 350°F Process and 75°F Avg. Ambient Temperature
• 8 MPH Average Wind Speed
• Fuel Source – Natural Gas @ $10/mcf
• Project Location – Orlando, Florida
• Insulation – Mineral Wool System with Aluminum Jacket
## EXAMPLE

### Heat Loss – Energy Conservation

<table>
<thead>
<tr>
<th>VARIABLE INSULATION THICKNESS</th>
<th>HEAT LOSS (BTU/FT/YR)</th>
<th>ESTIMATED INSULATION COST ($/LF)</th>
<th>ANNUAL COST ($/LF)</th>
<th>PAYBACK YEARS</th>
<th>CO2 EMISSION (LBS/FT/YR)</th>
<th>SURFACE TEMP. (F)</th>
</tr>
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<tr>
<td>BARE</td>
<td>23,180,000</td>
<td></td>
<td></td>
<td></td>
<td>3,376.0</td>
<td></td>
</tr>
<tr>
<td>1.5 INCH</td>
<td>1,200,000</td>
<td>$17.87</td>
<td>$18.56</td>
<td>1.2</td>
<td>174.7</td>
<td>101</td>
</tr>
<tr>
<td>2 INCH</td>
<td>954,900</td>
<td>$21.00</td>
<td>$16.27</td>
<td>1.4</td>
<td>139.1</td>
<td>92</td>
</tr>
<tr>
<td>3 INCH</td>
<td>679,100</td>
<td>$29.35</td>
<td>$14.76</td>
<td>1.6</td>
<td>98.2</td>
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The program exhibits a simple pay back calculation and does not include detailed additional financial benefits or Return on Investment considerations such as:

- Net Present Value of Money
- Asset Appreciation
- Free Cash Flow
- Extending the Life of Surrounding Equipment
- Improve “Life Cycle” cost

### Note

The table above shows the heat loss, estimated insulation cost, annual cost, payback months, CO2 emission, and surface temperature for different insulation thicknesses. The program does not account for detailed financial benefits or Return on Investment considerations such as Net Present Value of Money, Asset Appreciation, Free Cash Flow, Extending the Life of Surrounding Equipment, and Improve “Life Cycle” cost.
Cost of Operations – Return on Investment:
A failed insulation system is increasing annual operating cost and life cycle cost verses the purpose for which it was intended:

- Increased energy consumption
- Increased production cost – lower throughput
- Corrosion under the insulation is decreasing the life of the substrate thus increasing life cycle and annual maintenance cost in multiple areas
- Decreasing the life of the equipment due to operational demands and the affect on the surrounding work area
- Creating unnecessary risk in multiple areas including employee and community safety and regulatory concerns.
MECHANICAL INSULATION

A TIME TESTED AND PROVEN TECHNOLOGY

BUT.. IT MEANS CHANGE AND YES, THERE ARE BARRIERS TO CHANGE

Think About Insulation Differently
BARRIERS TO IMPLEMENTING ENERGY SAVINGS AND EMISSION REDUCTION INITIATIVES WITH MECHANICAL INSULATION

- Needs a “Champion” within the company and facility
  - Good or best practices in one unit/plant are not easily and widely diffused in organizations
- Lack of detailed knowledge on mechanical insulation systems
- Management – the decision makers need motivation to allocate attention and resources
  - A longer term financial model should be considered verses only examining short term results
  - Timely and effective insulation maintenance is an investment – not an expense. The damage or cost caused by reduced focus on mechanical insulation is often not identified
  - Slow uptake on energy savings projects and implementing technical or specification recommendations
- Energy is often not a line of specific accountability and not integrated with other business objectives
- Pressure from competing and often more “glamorous” initiatives

There has never been a better time than now to think about insulation differently
The Mechanical Insulation Design Guide (MIDG) was developed in conjunction with the National Institute of Building Sciences. It is an evolving web-based unbiased resource intended to assist the experienced professional, or novice user, with design guidance, system selection criteria and technology available with mechanical insulation systems in building/commercial and industrial applications.

It is a great educational tool for today’s youth

*MIDG is the most comprehensive mechanical insulation resource developed in decades and is it free!*

MIDG is a detailed “Decision Tree”

[www.wbdg.com/midg](http://www.wbdg.com/midg)
Developed In Conjunction with

Five Sections:

1. Design Objectives (9) and Considerations (6)
2. Materials & Systems
3. Installation Considerations
4. Design Data including online Calculators
5. Resource Information & Direct Linkage to Testing Organizations, Standards, Product Data Sheets, etc.

www.wbdg.org/midg
“On Line Calculators”

1. Service Temperature, By Product Type
2. Estimated Time for Fluid to Freeze in an Insulated Pipe
3. Temperature Drop – Fluid Flowing in a Duct or Pipe
4. Simple Thickness
5. Simple Heat Flow
6. Rate of Return on Investment & Emission Reduction

(Added to the web site on January 5, 2009)

MIDG is the most comprehensive mechanical insulation resource developed in decades and it is free
The Voice of the Mechanical Insulation Industry

www.insulation.org
The Voice of the Mechanical Insulation Industry
“INSULATION OUTLOOK”

Free Annual Subscription
Insulation…

Good For Business!
Good For The Environment!
Good For The Economy!

We need to think about insulation differently!

NEW CONSTRUCTION,
RETROFIT & MAINTENANCE - SERVICE MARKETS
Thank You

Insulation, The Forgotten Technology

Think About Insulation Differently

RonKingRLK@aol.com