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The Official Magazine of the National Insulation Association  
NOVEMBER 2020

outlook

A Look at

**CUI**

in

**Industrial  
Plants**

**PLUS**

**Current Priorities  
for Industrial  
Facility Owners**

**Creating  
Powerful Virtual  
Presentations**



# Whaddya Want Now??

## Current Priority Concerns of Industrial Facility Owners and Managers for Mechanical Insulation Systems

By Darrell Peil

? As new societal trends develop and regulations are implemented for managing an industrial facility, priority needs for owners and managers of these facilities change. The past priority needs may remain, in addition to the new; or they may fall by the wayside as more pressing subjects develop. Then, there are the basic needs and desires that always exist, to cap off the considerations that go into choices an industrial facility owner and manager make for their business. The intent of this article is not to focus on any *single* component of an insulation system as the major concerns are addressed, but to recognize that the entire assembly of all the components—and the practices employed in selecting and assembling the components of the systems—are the real determiners of the performance delivered by the insulation system. Too often, a silver-bullet solution for a concern is desired, and a designer or user of mechanical insulation will select one component to focus on as the sole solution to the concern being addressed. With mechanical insulation, *systems thinking* is as important as the piping and equipment that it is covering.

Many types of nonresidential buildings are categorized in the “industrial” classification of facilities, used across many segments of commerce for the production, storage, processing, distribution, and transport of a finished product of some kind. The finished products from these facilities range from

energy (in the form of fuels and electricity) to prepared food products ready for immediate use by the consumer. An industrial facility might be defined as any facility built for housing a given part of a process or a whole process, and meant to consider the process equipment needs, raw materials, or finished goods staging, and the needs of the typical number of personnel required to facilitate the process. An industrial facility can be any kind of construction, from those fully exposed to the outdoor environment, like tank farms and pipeline facilities, to fully enclosed facilities such as a paper plant that houses the entire production process and storage for finished goods. The range of common industries that exist and have a use for mechanical insulation in their facilities includes the following:

- Electric power generation—including conventional generation plants fueled by coal, gas, nuclear, or oil, and renewable electricity generation (most commonly photovoltaic solar and wind-powered electricity generation).
- Production/extraction of raw energy products like offshore/onshore oil and natural gas-processing facilities.
- Petroleum refining—facilities for hydrocarbon processing into fuels and feedstocks for chemical-processing plants.

- Chemical-processing facilities that are devoted to a wide array of petrochemicals or petroleum distillates like olefins and aromatics, specialty chemicals, and plastics (like polyethylene and polystyrene).
- Pipelines that transport oil, natural gas, and refined products from their point of production to loading terminals or storage facilities.
- Transport and storage terminals for oil, natural gas, refined products like gasoline and diesel fuel, and chemical storage.
- Metals and minerals facilities, including open and subsurface mines, mills, and processing plants for materials like iron ore, aluminum ore, gypsum, copper, gold, silver, feldspar, lithium, lead, nickel, beryllium, and molybdenum.
- Pulp, paper, and wood-processing facilities like mills for lumber; and for converting plants for paper or cardboard.
- Food and beverage processing, distribution, and storage facilities for meat, dairy, vegetable, and bakery foods; and fresh, preserved, and ready-to-eat products.
- Alternative fuels including solids, gases, and liquids production—like ethanol and biodiesel fuels.
- Industrial manufacturing for durable and nondurable goods production, including automotive, semi-conductors, plastic and rubber products, ceramics, textiles, building materials, and furnishings, among other manufactured goods.
- Pharmaceutical and biotechnology industry buildings, including manufacturing and research facilities.

All these industry owners have significant investments in plants, and they have many of the same desires for installations of mechanical insulation systems in those facilities. Today's owners and their facility managers are universally concerned with the key performance characteristics for mechanical insulation systems discussed below. The responsible teams for company facilities' investment are interested in finding systems that provide the most satisfactory

combination of these characteristics to deliver cost-effective investment (capital expenditures, or Cap Ex) and operations costs (Op Ex) over the life of the installation. The concerns of owners and managers have changed over time, and those concerns have been influenced by different forces and needs. OSHA requirements, Environmental Protection Agency (EPA) requirements, process changes, introduction of new materials to receive insulation (e.g., new kinds of metal alloys), solutions to old problems that move the focus to something else, societal desires (such as sustainability), and increasing management focus on operational subjects like safety or energy savings are examples of the kinds of drivers that influence the high-priority needs and desires of the industrial facility owner/operator/manager.

Today's major concerns for the industrial facilities design and operations team relate heavily to safety for personnel and the potential savings or costs associated with a good or negative safety record. This is safety as it relates to personnel and safety as it relates to preservation of facilities, and reducing losses associated with both.

### Corrosion and Corrosion under Insulation (CUI)

The top concern on the minds of the industrial facility manager for mechanical insulation systems today is the corrosion contribution properties or ability of the system to reduce corrosion of insulated systems. Owners and managers are interested in materials



that have been demonstrated to be noncorrosive to the piping systems and equipment that the insulation system is applied to. The major drivers for the high concern with corrosion are financial and safety issues. From a financial standpoint, a study conducted in 1998 identified the cost to the industrial manufacturing sector of the United States' economy to be \$159.7 billion annually from corrosion in general. From the standpoint of ensuring safety of plant personnel, corroded piping and equipment can present personal injury risk from leaking process fluids capable of causing a range of health problems (from irritation to major heat or chemical burns, and even death); high-pressure fluid or gas leaks that can cause significant personal injury, such as burns or amputation; slip-and-fall injuries caused by the leaked fluids; and collapse of equipment, which can crush personnel in a failure. Methods to control corrosion associated with insulated piping and equipment include selecting insulation materials that have specifically been tested, using standardized test methods, for their contribution to corrosion or compatibility with certain metals, or to demonstrate their content of potential corrosion-inducing components. A second step is to select a combination of system components and application procedures that are demonstrated to resist the intrusion of outside products—such as water or contaminants—that could induce the beginning of corrosion.

### Moisture and Moisture Transport Resistance

All insulation materials are subject to moisture retention to some degree and by some mechanism of retention. A complete system is required to keep moisture out of the insulation system. The concern over controlling the movement of moisture vapor or liquid moisture through the insulation envelope is a financial one, driven by potential costs associated with concealed decay or corrosion, possible health and safety concerns related to the impacts of unwanted moisture, and lost energy associated with wet insulation systems.

Moisture is one of the required elements for corrosion to establish itself. If moisture—in either vapor form or liquid form—can make its way into the insu-

lation system, the likelihood of corrosion or decay of insulated components increases, whether the components are constructed of metal or wood. A mechanism of corrosion that can be manifested with microbiological growth in moist industrial environments and processes is called microbiologically induced corrosion (MIC). MIC will cause piping and equipment to corrode to the point of failure, much like the more familiar forms of chemically induced corrosion. All the concerns and costs associated with the more common modes of corrosion are exhibited.

Microbiological growth requires a source of moisture to survive. Keeping this moisture out of the insulation system is key to avoiding personnel health problems induced by microbiological growth facilitated by wet insulation systems. Microbiological growth-induced health issues in the workplace can require personnel to seek medical attention and/or treatment, and they may need to take time off to recover from exposure to this growth. Personnel may need to be reassigned to other work areas, or work areas may need to be quarantined from service while the problem is remediated.

Another common industrial personnel safety concern is slip-and-fall injury. Small puddles of water are common causes of this injury type in ambient or heated industrial environments, and ice patches commonly form in industrial freezer environments. Dry, well-sealed, properly constructed insulation systems avoid this problem by not retaining or transporting moisture to an area where the moisture collects and drips; or by not allowing moisture to form on cold operations systems in warm environments, preventing water formation from condensation.

Moisture in the insulation system also results in excessive costs caused by inefficient operation of processes, bringing the need for greater energy input to temper the process, cold or hot. Wet insulation systems do not slow thermal energy flow and turn into energy conductors. This conduction of energy is usually not desired, and it impacts the cost of energy required to operate the process. Another expense of a process that cannot operate at the proper temperature is a failed process, which causes cost through lost productivity, manifesting itself in poor-quality

product(s) that cannot be sold, increasing cost through generation of scrap. Additional cost also results from a process that must operate at a rate other than maximum efficiency to avoid poor-quality, unsalable finished product. The savings from an insulation system designed and installed to keep water out can be very attractive when saved energy and the efficiency of a properly operating process are considered.

### **Compression Resistance**

Industrial facility owners/managers routinely ask for mechanical insulation systems that resist compression from applied loads. Typically, a load or impact comes from a plant operation that unintentionally imposes force on the insulation system, which results in permanent crushing of certain systems that have not been designed to resist compression loads. The most common scenario for compression force being applied is maintenance and repair operations, when the insulated system is walked on (such as a duct top), used as a stepping surface (like a pipe that is used as a ladder rung), or when access equipment is leaned against the system for support. Another common situation that results in unintended crushing impacts is where there is a high-traffic area with lower headroom or tight passageways for the intended access. Truck traffic, forklift routes, materials handling, or process activity are conditions in the industrial facility to consider when thinking of insulation systems that will be durable and serviceable in the face of heavy imposed loads and impacts.

The costs associated with compressed/crushed insulation systems come from the need to repair or replace the damaged areas of the system, the extra expense associated with operating a system that has excessive energy input to make up for the energy losses associated with compressed insulation systems, and the loss of effective operation of the system/process associated with excessive thermal energy conduction.

The repair/replacement expense is self-explanatory. Early design, material selections, and installation practices can avoid this expense. Many times, insulation system component combinations are selected for

considerations other than the ability to resist compressive force. Like many choices, not considering compression resistance can be expensive if the repair/replacement expense becomes a repeated, planned activity. One time incurring repair cost is painful enough, if the damage is unanticipated. Repeated repair and replacement is unfortunately commonplace, as facility managers replace damaged systems with new materials/components of the kind that were originally installed, even if the system does not provide the desired impact/crushing resistance.

Crushed insulation systems change the transfer rate of energy in direct proportion to the amount of crushing/compression. If a system is compressed 50%, energy transfer increases 50%. These changes in heat transfer rate, either gain or loss, can severely impact process operations; and these impacts can exhibit themselves in process output rates or product quality, much the same as with wet insulation systems. The effect is the same: higher-than-planned energy conduction. In addition, many times, a compressed insulation system leads to a wet insulation system, so the process eventually suffers doubly from both conditions.

Selection of insulation system components—the insulation product, the protective finish/barrier, and the proper methods of installation—is key for compression resistance. Component selections can yield a long-lived, cost-effective system that does what is desired; or they can yield a high-cost, short-lived system that delivers sub-par performance. There is the choice of lower compressive-strength insulations with highly durable finishing materials meant to carry loads and resist impact/compression. The other choice is higher-strength insulation materials that provide harder substrates to support less resilient finish materials and practices. It is important to consider what really is needed from the finished system, as a system.

### **Fire Resistance**

Industrial facility owners and managers are acutely aware of the fire-resistance and combustibility properties of systems; and fire resistance ranks alongside corrosion as a top-priority concern for industrial

operations. Industrial fires are a common occurrence, present a high level of threat to the safety of employees, and are very expensive; so any way to mitigate the impact of or avoid the potential for a fire in the industrial environment is sought out. The drivers for insulation systems that offer exceptional fire resistance are safety for personnel, risk reduction, insurance expense reduction, and loss reductions.

First and foremost, plant management has concern for personnel safety in all aspects of operations. Fire safety, both in the form of potential for support of combustion and the generation of products of combustion, is a prime consideration in materials chosen for many industrial projects/facilities. Insulation systems components, in the industrial environment, are often qualified for initial consideration or rejection based on potential fuel contribution (fuel for), support of fire (flame spread), and volume generation and contents of combustion gases (smoke generation/hazardous gas content). Fire resistance is critical for personnel safety by allowing more time for escape before a fire stops evacuation, lessening threat to safety during egress, or offering more safety in the event a person has to take refuge in the facility. Evaluation of insulation system components for lower levels of smoke and hazardous gas emission is significant because smoke and toxic gases are well documented to be more lethal in fires than heat.

Systems that provide low levels of fuel or minimal support for combustion are desired. Lower potential for burning reduces the risk of a fire starting, reducing losses experienced from industrial fires. Low-contributor systems, composed of low-contributor materials, have the impact of limiting the spread of and damage from a plant fire. Systems with low-fuel contribution assist in controlling and extinguishing a fire, limiting the losses in the event a fire starts.

Risk of a fire even starting is reduced by selecting

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systems that offer high levels of fire resistance; and reducing the risk that a fire may start can yield a reduction in insurance premiums for the industrial facility owner.

Some insulation systems are selected and installed to prevent damage to facilities in the event of fire, or they are meant as fire-containment systems. The combination of certain system components may offer a strong level of resistance to

combustion and an ability to control heat being conducted at high temperatures. This can prevent other materials from catching fire or failing due to heat fatigue and melting. Stopping fire from affecting certain installations is particularly important in facilities that produce and/or store highly flammable products, like petrochemical facilities.

### **Reduced First Cost of Facilities**

Industrial facility owners and managers are under constant pressure to deliver capital investment projects less expensively, while still delivering facilities that produce finished goods with the level of service and quality desired. Business metrics like return on assets and return on equity to measure efficiency in use of money are high-visibility key performance indicators for an industrial company, and especially important to the capital-intensive nature of industrial production. Insulation systems fall in the category of investments that are capital, hence subject to this financial review.

Some insulation systems, components, and installation practice developments deliver both cost advantages and the performance levels needed, including first-cost savings. These savings come in the form of easier, faster-to-install systems, including more factory-fabricated/assembled components. Product developments have introduced more durable products at lower cost—products that change what is used for a particular part of the system. As long as there is the financial performance drive, there will be developments targeted to meet the need for reduced first cost in the insulation industry.

## Acoustical Control—an Up-and-Comer

A need that is increasing in terms of both public awareness and consideration recently is acoustical control in industrial facilities. This need is being driven by safety considerations for personnel, regulatory actions restricting sound levels (both inside and outside the facility), and the goal of cost control via managing losses due to medical and noise-abatement suits from the surrounding community. Personnel safety concerns relate to avoiding hearing losses associated with long-term employment in loud industrial environments. Regulatory actions and rulings implemented by OSHA to address the same concern are reducing noise exposure levels in the workplace. One way to reduce the noise level in an industrial environment is to add acoustical insulation systems to piping and equipment, or to build sound enclosures engineered with insulation systems to reduce process-generated noise. The EPA has been regulating environmental noise levels from certain industrial facilities, as they are constructed, to restrict the sound emanating from the facility. Again, these regulated levels can be achieved quickly and cost-effectively with sound-control constructions/systems built using current components in the market.

## The Bottom Line: Solutions Do Exist that Will Meet Industrial Facility Owner and Manager Needs

The properties discussed above all have standardized test methods for materials to demonstrate and quantify the characteristic sought. The same cannot be said for systems. It is up to an industrial facility's engineer

and manager to evaluate the components for inclusion in a system that will provide these priority needs, as well as the basics. Continuing to use prior practices that do not meet needs is an exercise in waste, given the possible selections and combinations available in today's mechanical insulation market. Solutions exist for the conditions experienced in the kinds of common industrial facilities described in this article. It may take some time and creativity on the part of the industry to get the correct solution for the challenge at hand, and some solutions are less popular or promoted, but some very creative solutions to difficult problems exist in the industry, including from smaller suppliers of products and services. Do not give up! Keep asking and the right answer will be found. ☺



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