



COAL-TAR ROOFING SYSTEMS – *Rugged, Recycled, Reflective, Reliable!*

By Kevin Ochis

OVERVIEW

Built-up roofing systems using coal-tar pitch continue to represent an important option for building owners, roofing contractors, and specifiers. In many situations—roofs with prevalent ponded water, roofs with heavy maintenance traffic, water-cooled roofs, and roofs in areas prone to hail—coal-tar roofing systems are the ideal solution. In roofing configurations where the use of tapered insulation would be difficult or impossible because of flashing heights; drain locations; or door, window, or wall heights; coal-tar pitch roofs may be particularly appropriate, especially on roofs where longevity is important.

Following are some important considerations for selecting a coal-tar roofing system.

BASIC PROPERTIES OF COAL-TAR ROOFING MATERIAL

Coal tar is composed of ringlike hydrocarbon molecules that provide a natural resistance to water, ultraviolet rays, oxidation, chemical attack, and degradation from the harshest atmospheric conditions. Equally important, coal-tar pitch has unique cold-flow and self-healing properties, unlike other roofing and waterproofing products. Although it appears solid, coal-tar roofing pitch is able to flow at warm rooftop temperatures—the warmer the tempera-

ture, the greater the rate of flow. This ability to flow permits the membrane to continuously adjust to changing conditions, sealing minor fractures and abrasions, hail damage, and other stresses that could otherwise accelerate the membrane's aging process.

WHY CHOOSE A COAL-TAR ROOFING SYSTEM?

There are many benefits to coal tar as a roofing system, including those listed below.

Lower Life Cycle Cost

There are few commercial roofing systems that outperform coal tar when evaluated in terms of life cycle cost of a roofing system. Based on anticipated years of service (combined with low maintenance costs and other factors), coal-tar roofing can be one of the most economical roofing solutions available for flat or low-slope roofs. Carl Cash, a noted authority in the roofing industry, reported the results of a study that determined only metal roofing systems have an average service life greater than coal tar, and metal roofs are typically specified on higher-slope installations.

While coal-tar roofing systems do not typically represent the lowest initial cost of installation, their resistance to harmful elements and their self-healing properties offer systems with low maintenance requirements and long life. There are coal-tar roofs known to still be performing after 50, 60, and 70 years. Thus, their life cycle costs are generally lower than other types of roofing systems. Even on an initial-cost basis, coal tar can sometimes be surprisingly competi-

What Is Coal Tar?

Coal-tar pitch starts as a byproduct of the coking process used in the steel industry, where bituminous coal is heated to 1,800° to 2,200°F in the absence of air, releasing the volatile compounds in the coal. The remaining coal, now called coke, is used in the production of steel. In order to recycle the volatile compounds, these compounds are collected and cooled. After initial separation, the resulting crude coal tar is then further processed to produce various types of coal-tar materials, including those used to make roofing pitch.

Different grades of coal-tar materials are used for road materials, as well as a variety of adhesive and industrial coatings. Other coal-tar chemicals produced during refining are used in medicines, cosmetics, dyes, and plastics.

tive, especially when the costs of installing tapered insulation and associated costs can be avoided.

Self-Healing Properties

Coal-tar roofing pitch has inherent cold-flow characteristics, meaning that cracks and surface damage that occur during colder weather will be healed by the roofing pitch flowing back together during periods of higher temperatures.

Resistance to Ponded Water

Virtually unaffected by water, coal tar does not dissolve when exposed to moisture, thus making it an ideal product for use in ponded water and below-grade waterproofing situations. Ponded water can actually increase the life of a coal-tar roof by keeping it cool. As the water evaporates, it carries heat with it, keeping the roofing membrane and the building cooler. (See *Photo 1*.)



Photo 1 – Coal-tar roof with ponded water.



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Photo 2 – Reflective rock as installed.



Photo 3 – Reflective rock after 28 months.

Ideal for “Green Roof” Installations

With proven resistance to constant immersion in water and recognized resistance to biodegradation and vegetation root attack, coal-tar roofing systems are the material of choice for vegetated roofs. In surveys of roofing experts, coal-tar roofing material is considered more durable than asphalt, EPDM, TPO, PVC, or other products. Additionally, coal-tar products are postindustrial recycled

products and exemplify the diversion of an industrial waste product into a viable high-performance building product.

Sustainability

As a postindustrial recycled product (a byproduct of steel production), coal-tar roofing pitch qualifies for LEED® credits. After processing, coal-tar roofing pitch becomes one of the toughest and longest-lasting roofing products around, keeping buildings and insulation dry, thereby maximizing the life of the roofing membrane and insulation and,

importantly, minimizing landfill volume. A well-installed and well-maintained coal-tar roof can last for the life of a building.

Longevity

Coal-tar roofing systems have 125 years of time-proven history as one of the longest-lasting, most rugged, flat and low-slope roofing technologies available. Period.

Hail Resistance

Coal-tar roofing exhibits superior performance in regions prone to hailstorms.

Its abuse-resistant properties and ability to self-heal small cracks and punctures during warmer summer months will often prevent a small problem from becoming a large problem. In most cases, hail simply bounces off the rock surface of a coal-tar roof.

Abuse Resistance

Due to coal-tar roofing systems’ multiple construction, high completed-system thickness, rock surfacing, and self-healing characteristics, they exhibit superior abuse resistance properties.

Fire Resistance

Coal-tar roofing systems have excellent natural fire resistance over the long term, requiring no fire-retardant (FR) chemicals, so there is no FR- or non-FR-grade product. This is largely due to the rock or slag aggregate surfacing. (As they say, rocks don't burn.)

Vapor Permeance

Coal-tar material has an extremely low vapor permeance, contributing to its excellent performance in ponded water conditions and in climates and conditions where there is a vapor drive into a building.

Simple Construction System

A typical simplified coal-tar roofing system consists of 1) one or more layers of insulation installed over the roof deck, 2) a coverboard installed over the insulation, 3) three to five layers of reinforcing plies installed 4) in a flood coat of coal-tar roofing pitch, and 5) an aggregate surfacing on top. Common variations are plies installed directly to a concrete deck, or the first ply consisting of an asphalt base sheet installed in hot asphalt.

Thick Membrane

Coal tar's multiple-ply construction, flood coat, and aggregate-top surfacing give these roofing systems one of the thickest membranes of any roofing technology on the market, with a typical thickness of several hundred mils. In addition to its water resistance and self-healing properties, this system thickness reduces the chances of water getting through the membrane—both in its early years and throughout its extra-long life span.

Reflectivity

White reflective rocks (with a solar reflective index higher than 78) can be used if a reflective roof is desired. Because these rocks are largely self-cleaning, this reflectivity is not significantly reduced as the roof ages.

To maximize reflectivity, the flood coat and rock layer can be performed in two steps: one application of rocks in a flood coat of pitch, and a second application of rock only to dress up the roof surface. (See *Photos 2* and *3* for a roof with reflective rock after installation and over two years later. See *Photo 4* for an example of self-cleaning rocks. Rain washes dirt below the top surface, maintaining the reflectivity of the top surface.)

Availability

Coal-tar roofing products are available throughout North America.

COAL TAR + PROTECTED MEMBRANE SYSTEMS = EVEN LONGER LIFE

Protected roofing membrane assemblies (PRMAs), sometimes referred to as inverted roofing membrane assemblies (IRMAs), represent a new paradigm in roofing methods. In a conventional roofing system, the insulation layer is installed over a roof deck, and

the roofing membrane is installed over the insulation layer. However, in PRMA roofing systems, the roofing membrane is installed over the roof deck, and then insulation (typically extruded polystyrene) is installed on top of the roofing membrane. Finally, a filter fabric, along with ballast rock or pavers, is installed over the insulation. These systems protect the roofing membrane from being damaged by the sun and traffic on the roof, as well as from membrane temperature changes—some of the leading causes of



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Photo 4 – A handful of rock showing the top rain-washed layer and dirty lower layer.

roofing systems' demise. Coal tar is the ideal roofing membrane for PRMA roofs because it is not affected by extended contact with water.

In addition, since a PRMA roofing membrane is under the insulation, flashing heights are less likely to be an issue. Installing a PRMA system is simpler to schedule, since there are fewer steps between tearing off the old and completing the new roofing membrane. The insulation can then be added on a more-flexible schedule. From a quality control perspective, one of the greatest risks to a roofing system installation is poorly adhered insulation. PRMA completely removes this risk. Also, if a building owner is concerned that energy costs may increase in the future, a PRMA system makes it easy to add insulation if necessary.

In the event there is a leak in an IRMA/PRMA roofing membrane, there is no wet insulation to cut out and no ugly patch. The insulation is removed, the repair is made, and the insulation is replaced. New curbs can also be easier to install or to remove if no longer needed. When a roof eventually does have to be replaced, or even if a building is being torn down, the extruded insulation can be easily removed and reused,

reducing the volume of material going to landfills. (See Photos 5, 6, and 7 for a PRMA roof membrane before insulation, as the insulation is being installed, and as the filter fabric and ballast rock are being installed.)

DIAGNOSING A LEAK IN A COAL-TAR ROOFING SYSTEM

When diagnosing a reported leak in a coal-tar roof, there are several considerations. A properly installed coal-tar roof will very rarely leak in the field of the roof. Therefore, other possible causes for apparent leaks should be thoroughly investigated. As with all roofing leaks, it is critical to determine if the HVAC system or plumbing is generating the observed water. Also, it is possible water is entering through walls, engendering a leak report not caused by a roof leak. If the above conditions are eliminated as the source of the water entering the building, the next areas to examine are the flashings and stripping plies. If the main field of the roof is leaking, often the cause is a split or blister in the roofing membrane. However, the mere presence of a blister does not necessarily mean the blister is leaking, since some blisters can last leak-free for years. Since most coal-tar roofing systems are flat or extremely low-slope, a water test

performed in carefully defined areas of the roof can be a particularly useful tool in leak diagnosis.

EVALUATING A PITCH ROOF FOR REPAIR/REPLACEMENT

Determining whether a coal-tar pitch roof needs minor maintenance, a restoration, or replacement is not always obvious from the appearance of the roof alone. Sometimes the surface of a coal-tar roof can appear dirty and worn, or the flashings can be obviously deteriorated, but the actual main field of the roof is still in good shape.

To best determine if the roof needs to be reflooded, resaturated, or completely restored,

one method is to make a 12- by 12-in. test cut, separating the membrane from any insulation and aggregate. Let it warm up in the sun, and then slowly bend the membrane. If it seems flexible, there is likely still life in the roof, and it should either be reflooded (with coal-tar roofing pitch) or resaturated (with coal-tar resaturant).

Another way to determine the condition of the roof is to take a test cut on a warm, sunny day; remove as much rock as possible; and leave it out in the sun for a few hours. If the coal tar gets shiny black and softens, it indicates the coal-tar pitch still has cold flow and is yet active, and the membrane is likely still in good shape.

Generally speaking, coal-tar roofing systems can almost always be restored. It seems counterintuitive, but a restored coal-tar roof will likely last longer than many new roofs; plus, it is often less expensive. In some ways, it is like an old hardwood floor. Why replace it if all it really needs are a few spot repairs and a good sanding and refinishing? In most cases, refinishing is likely the cheapest and longest-lasting option. Similarly, restoring a coal-tar roof is often a cheaper and longer-lasting solution than a new roof. However, if there are a large number of splits, blisters, and other repairs



Photo 5 – A PRMA roofing membrane before installation of insulation.

that need to be made, there comes a point when it makes more sense to remove and replace the entire roof. Also, if the original installation has issues, it may not be a good candidate for anything but replacement.

PROPER MAINTENANCE EXTENDS THE LIFE OF COAL-TAR ROOFING SYSTEMS

Coal-tar roofing systems typically require minimal maintenance, but it is important to

follow basic guidelines to ensure that even older coal-tar roofs can have extended life for additional decades. If a coal-tar roof system is in reasonably good shape, it can be extended for up to 20 or even 30 years by performing basic repairs and adding a new flood coat and aggregate (or applying a tar saturant and aggregate) to the field of the roof.

In many cases, the only reason a coal-tar roof leaks is due to deteriorated flashings

Benefits of Coal-Tar Roofing Systems

- Cold flow/self-healing properties
- Excellent resistance to ponding water
- Durability to prolonged weather exposure
- Natural resistance to oxidation
- Resists water and vapor penetration
- Resists insect damage
- Resists most chemical attacks
- Natural resistance to UV exposure
- Redundancy of up to five plies of coal-tar pitch and felt
- Low maintenance cost
- Maintainable
- Recyclable
- Achieves LEED® points
- Eliminates expensive tapered insulation costs



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Photo 6 – A PRMA roofing membrane with insulation being installed.



Photo 7 – A PRMA roofing membrane with filter fabric and ballast rock being installed.

and stripping plies; thus, the condition of flashings, drains, edge metal, pitch pockets, stripping plies, etc. should be evaluated and maintained or replaced at regular intervals. At the time of the restoration, the flashings and stripping plies should be evaluated and either maintained or replaced, splits and blisters and other repairs should be made, the loose rock and any debris should be removed, the surface should be primed with tar primer, and a new surfacing of coal-tar roofing pitch or coal-tar resaturant and aggregate should be installed.

A new flood coat of coal-tar roofing pitch is done hot, and a coal-tar resaturant is cold-applied with a spray rig or squeegee. A reflow provides a new weathering surface. A coal-tar resaturant is intended to rejuvenate the old flood coat and organic plies by adding oils,

in addition to providing a new weathering surface. A reflow is used on newer roofs because they only need to be protected, not rejuvenated, and do not need the oils

contained in resaturant. It is important that all repairs be made with compatible materials, both for minor repairs as well as restorations.

Periodic inspections by a roofing contractor or roof consultant can discover potential roofing problems that can then become opportunities to extend the life of the roof by means of a comprehensive restoration, ultimately saving the building owner from the major expense and disruption caused by a complete roof tear-off and replacement. Restoration projects are typically faster and more predictable than a comprehensive tear-off and replacement project; thus, they often result in higher margins for roofing contractors.

A newly installed coal-tar roof will typically exceed 20 or 30 years; and if proper maintenance procedures are followed, a reflow will provide another 20 or 30 years of service; and after that, a resaturation that can activate the top pour of pitch can further extend that service another 20 or 30 years. This represents a potential 60- to 90-year life span or longer for coal-tar roofing systems. Of course, this is a potential life span assuming that proper maintenance is performed. If proper maintenance is not performed, this potential life span will not be achieved.

In most cases, this maintenance can be deducted from taxes at 100% right away, providing additional value to maintaining a roof versus replacing a roof, which would generally have to be deducted over as much as 40 years.

IMPORTANT CONSIDERATIONS WHEN SPECIFYING COAL-TAR ROOFING SYSTEMS

Migration

Because coal tar has cold-flow properties, it provides “self-healing.” However, this property also means that coal tar should only be specified in flat or low-slope roofs with slopes of no more than ¼ or ½ inch per foot, depending on the system. Provisions should be taken to prevent the undesired migration of the pitch, including constructing envelopes, pitch dams, and similar barriers.

While many experienced roofers and specifiers are familiar with coal-tar pitch for flat roofing systems, those new to coal tar should get a refresher course in its proper installation. Remember that coal tar is an excellent roofing material; but like any roofing system, it must be properly installed and only used in appropriate applications.

Fume Control

Coal tar has a strong odor when heated. Appropriate provisions should be made for

controlling odors. Measures can be taken, including keeping people informed, closing vents, closing windows, utilizing kettles with afterburners, using fume recovery systems, etc.

Contamination

It is critical for safety and roof integrity that separate kettles and “luggers” be used for heating coal-tar pitch and asphalt material. Hot asphalt must not be put in a coal-tar kettle or lugger, and vice versa.

Insulation

Coal-tar pitch roofs utilizing isocyanurate (iso) insulation should have a separate coverboard, fully mopped in asphalt. The coverboard should be staggered so that whenever possible, joints in the coverboard do not overlap joints in the iso. If the iso is mechanically attached, the mopped coverboard isolates the fasteners from the roofing membrane, providing protection from a number of things, including fastener back-out, fastener heat transfer, and air move-



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ment and vapor drive along the fasteners. This compact construction also provides additional strength and resilience to the roofing system. The fully mopped insulation layers also provide a barrier to air movement through and within the insulation layers. In some climates and vapor-drive situations, it is important to control air movement to resist the accumulation of moisture in the insulation layers.

Details

Base flashings are typically asphalt-based on coal-tar roofs. Since flashings are generally a steep-slope issue, coal tar's cold-flow properties make it difficult to use in this application, and the steep slope reduces the need for coal tar's resistance to water. Even on steep slopes, the flashings often deteriorate before the coal-tar field of the roof and are therefore an important and cost-effective maintenance item. A common base-flashing configuration is a backer ply with a granulated modified-bitumen top ply. These flashings are typically applied in hot asphalt, but are sometimes cold- or torch-applied. For the best possible roofing installation,

it is important to follow manufacturers' recommendations and best practices on various details such as drains, flashings, corners, edges, and other flashing conditions. Details for common situations are often available on manufacturers' websites.

Safety

As with many commercial products, proper health precautions and safe handling procedures must be observed. Coal-tar roofing pitch is heated during the application process, requiring that safety precautions for hot materials be followed.

According to the Department of Labor's Occupational Safety and Health Administration (OSHA), the permissible exposure limit (PEL) for the volatile compounds that evolve from materials such as roofing-grade coal tar was established at two-tenths of a milligrams per cubic meter (0.2 mg/m³) of the benzene-soluble fraction (amount of airborne particulate matter in the air that can be dissolved in benzene). This standard has remained constant since 1970.


Scientific investigations by OSHA have established that when heated, coal-tar pitch yields polycyclic aromatic hydrocarbons, a substantial portion of which are suspected or known carcinogens. In a study conducted in 1979 and 1980 under the aus-

pices of the National Roofing Contractors Association (NRCA), Dr. Jerome Thomas of the University of California evaluated the extent of workers' exposure to emissions originating from hot asphalt and coal-tar materials. Thomas's studies concluded that most of the cases in which applicators were working outside of OSHA standards were the result of overheating the materials, poor working practices, and undersized and broken equipment.

As with other materials, consult the material safety data sheet for additional information.

CONCLUSION

Time-proven and field-proven coal-tar roofing systems provide building owners with a variety of benefits. Coal tar provides the ideal chemical and physical characteristics for resistance to degradation from nature's most menacing solvent—water—in all its forms. Coal tar's cold-flow and self-healing properties provide natural resistance to ponded water, oxidation, and chemical attack and offer low-maintenance cost and warranties with no exclusion for ponded water.

Many of these benefits have been overlooked in recent years. Coal tar merits consideration as a roofing material of choice by quality- and cost-conscious owners. 

Kevin Ochis



Kevin Ochis is president of Durapax Coal Tar Commercial Roofing Systems. Ochis gained experience at a major manufacturer in various capacities, including financial, marketing, and operations roles, before leading the roofing division. Kevin has a bachelor of science degree from Penn State University and a master's degree in business administration from Duke University.

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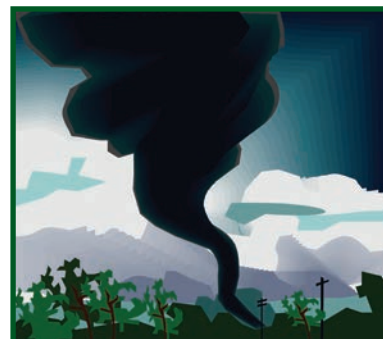


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The U.S. suffered \$11 billion worth of weather disasters in 2012, the second highest amount for any year on record—right behind the most disastrous year of all: 2011.

— ENR