Built-up Roofing Systems Survive

Coal tar and asphalt built-up roofs, collectively referred to as BUR systems, have represented the norm in the low-slope commercial roofing industry for more than a century. Recently, new technologies, including single-ply and polymer-modified bitumen membrane systems, have attracted a significant portion of this market. Most of these systems promote some sort of innovative change; unfortunately, more often than not, innovation in one area compromises another. For example, systems that demonstrate an easier and faster installation often cannot match the long-term performance history of those that may take longer to install. On the other hand, a newer system, designed for long-term performance, typically carries a higher cost. Although every roofing customer would like the best of both worlds, building owners, specifiers, and roofing contractors will continue to be challenged with determining the true value of a roof and compare that to their goals and budget.

The objective of this article is to offer a closer look at how some of the new technologies have brought coal tar back into the spotlight. Economical, durable, and long-lasting coal tar roof systems appear once again to be gaining the support of building owners and roofing professionals.

Installation of a polymer-modified coal tar membrane.

Industry Becomes More Complex

Things have changed significantly since the time when coal tar and asphalt BUR dominated the low-slope roofing market. The low-slope roofing industry has become much more complex. A variety of different systems have flooded the marketplace, and building owners are now confronted with the decision of choosing between EPDM, PVC, TPO, Hypalon, modified bitumens, and built-up roofing – just to name a few. Each has its own characteristics, physical properties, recommended uses, and performance history. While some of these roofing systems have performed well when installed properly, others have not lived up to customer expectations.

Asphalt and coal tar systems are still a vital part of the low-slope roofing industry. Asphalt plays a key role in BUR and modified bitumen systems. Coal tar, often thought to be a product of the past, is gaining popularity, not only in its traditional form as a built-up roof, but also in several other forms. Polymer-modified coal tar membranes and polymer-modified, mopping-grade coal tar pitches are gaining widespread market attention.

Coal Tar’s Natural Advantage

It’s hard to find anyone with a background in the commercial roofing industry who doesn’t have a respect for the historical performance record of coal tar systems. There is no secret to why it
Coal tar built-up membrane utilizes traditional application methods. Coal tar built-up membrane utilizes traditional application methods. Coal tar built-up membrane utilizes traditional application methods.

Coal tar built-up membrane utilizes traditional application methods.

Coal tar performs as well as it does. Coal tar has a molecular structure that provides natural resistance to water, ultraviolet rays, and chemicals that are commonly found on a rooftop environment. Equally important are coal tar’s cold-flow/self-healing properties; no other roofing or waterproofing product offers this feature. Although it appears solid, coal tar roofing pitch is able to flow at normal rooftop temperatures – the warmer the temperature, the greater the rate of flow.

It is this ability to flow that allows the membrane to continuously adjust to changing conditions, sealing minor fractures and abrasions that could otherwise accelerate the membrane’s aging process. Coal tar’s resistance to harmful elements and its self-healing properties offer a system with low maintenance requirements. It is not uncommon to find coal tar roofs providing satisfactory performance after 40, 50, and even 60 years.

Understanding Coal Tar

Although the use of built-up roofing systems in recent years has been somewhat affected by the introduction of numerous single-ply systems, it appears that the use of coal tar has also been affected by several misconceptions. Like silica (sand), wood dust, and gasoline fumes, as well as some other products used in the roofing industry, coal tar is classified as a carcinogen. What does this mean? If someone improperly uses these materials, he or she faces a potential risk. Experience tells us, however, that like these other materials, coal tar roofing products, handled properly, can be used safely. The industry provides specific handling and safety information to its customers to help ensure proper use of such materials.

There are several other common misconceptions related to the use of coal tar roofing systems that should be addressed. Coal tar roofing products are available in all North American markets. There are no regulations that prohibit their use, and they can be disposed of in any approved landfill. Although there are some roofing contractors who choose not to install coal tar systems, there is a nationwide network of contractors who promote and install coal tar systems on a regular basis.

Technological Innovations

In recognizing the adaptability of coal tar, several suppliers have introduced new and innovative products over the past ten years. In many cases, these products typically combine the traditional elements of coal tar with an innovative polymer modification system. The research and development associated with these new technologies have led to several interesting discoveries. Questions relating to the use of polymer modified products in conventional, built-up roofing applications were addressed during the development phase. The primary question was: when used in a built-up membrane assembly, would the polymer modifications negatively impact the long-term performance of the roofing systems?

It is generally understood that polymer modification provides roofing bitumen with enhanced physical properties, most notably greater flexibility, particularly in colder temperatures.

Coal tar fortified restoration products can be utilized on existing asphalt, as well as coal tar membranes.
Developmental work with coal tar has demonstrated some surprising results. Asphalt has historically been considered more flexible than coal tar when the temperature falls below 6°C (42°F), widely considered coal tar’s glass transition point. From this, it would be easy to presume that if asphalt and coal tar were polymer modified in a similar fashion, coal tar’s cold flexibility properties would similarly improve, still leaving asphalt with greater cold flexibility properties at lower temperatures.

However, this is not the case. Polymer-modified coal tar has better cold temperature properties because of how the coal tar and the polymer link together. To better understand the difference, both asphalt and coal tar modified bitumen membranes were tested using industry-recognized cold flex test methods. The asphalt membranes performed well down to temperatures ranging from -18°C to -25°C, (0°F to -13°F). In contrast, the polymer-modified coal tar membrane performed well under identical conditions at temperatures as low as -60°C (-76°F). This type of information, although interesting, does not offer much in the way of predicting a product’s overall performance.

To get a better understanding of the long-term performance of these membranes, and to try to predict how they might perform in actual use, an independent laboratory competent in these procedures recently conducted accelerated weathering tests. The test subjected both a coal tar-modified membrane and a popular asphalt-modified bitumen membrane to a variety of weathering conditions, including ponded water. The primary focus of this testing was to determine the ability of these products to retain their physical properties over time.

Weathering tests were carried out in accordance with the ASTM D 4799,1 “Standard Method Test for Accelerated Weathering Conditions and Procedures for Bituminous Materials” (fluorescent UV and condensation method, 3,000 hours), and ASTM D 4798,2 “Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Procedures” (Xenon-arc method, 6,000 hours).

The test specimens were exposed to various conditions as prescribed by the test method. Half of each specimen was submerged...
in water because coal tar membranes were reported to have water-resistant properties similar to the original coal tar pitch products. The test specimens were subjected to thermal cycling in conjunction with wetting and drying. After conditioning, the specimens were tested for low temperature flexibility and examined by transmission electron microscopy to look for changes in compound structure. The test confirmed that the modified coal tar membrane submerged in water for 6,000 hours, as well as the portion above the waterline, had the same low temperature flexibility (-60°C, -76°F) exhibited by the membrane prior to testing (Photo 1).

In comparison, low temperature flexibility testing was also performed on the asphalt specimens following exposure. The asphalt-modified compound lost 8.6°C (15°F) in low temperature flexibility after exposure. The portion of the asphalt submerged in water during testing clearly showed signs of shrinkage due to the loss of soluble compounds in the asphalt polymer blend. The coal tar membrane’s superior performance is a direct result of how the coal tar links with and protects the polymer. Frank Moore, manager of Technical Services at Honeywell Commercial Roofing Systems, stated, “The polymer additives bring improved physical properties to the composite membrane; however, their ability to resist the deteriorating effects of rooftop conditions, in some cases, is less than the bitumen alone. The asphalt’s inability to adequately protect the polymer leads to the degradation of the membrane compound.”

This study concluded that the coal tar in the coal tar membrane compound protects the polymer from oxidation, thereby allowing the membrane to retain its original physical properties. This appears to confirm that, when used in a built-up roofing assembly, the modified coal tar membrane performs similarly to the traditional coal tar roofing pitch and would not compromise the long-term performance of the membranes.

New Applications

Polymer-modified tar is now offered in several forms. In addition to incorporating a polymer-modified membrane into a built-up roofing assembly, there is a new generation of polymer-modified, hot-applied coal tar pitch. Several suppliers are now offering this type of product for use in a range of BUR applications, including membrane construction and restoration. These systems use inorganic ply felts such as fiberglass, polyester, or a combination reinforcement. This product type can also be used as a surface coating for traditional coal tar built-up membranes.

Although the addition of a polymer alters the compound’s cold flow properties, most manufacturers have developed formulations that retain at least some of this property. It is anticipated that, in the near future, we will see built-up roofing assemblies that incorporate the polymer modified membranes set in hot moppings of a polymer-modified bitumen.

“Coal tar is generally accepted as one of the premier materials available for construction of a low-slope roofing system,” said Ken Brzozowski, director of research and development at W.P. Hickman Systems, Inc. “We feel we have made a great product even better through the use of rubber modifiers that improve low temperature performance, fatigue resistance, and adhesion properties. The acceptance of these improvements is demonstrated by the steady growth of sales we are experiencing with the product line.”

Cold Applied Systems

Cold-applied coal tar systems are also gaining popularity. Although there are now filtration systems capable of cleansing the fumes from a roofer’s kettle, an increasing number of building owners are attempting to avoid all fume conditions whenever possible. Several coal tar suppliers are now offering membrane systems that can be constructed using a cold-applied adhesive. The modified coal tar membrane used in a multi-ply configuration can also be heat welded, producing the least amount of odor. Additionally, several suppliers are offering cold-applied, polymer-modified roofing compounds that can be used in the construction of a built-up system using either fiberglass or polyester felts. These products are also recommended for repairs when the use of a roofing kettle is not practical.

With a questionable economic forecast, an increasing number of building owners are starting to look at ways to get more life out of their existing bituminous membrane systems. One supplier is now offering a coal tar-enhanced product that has been formulated to deliver many of the same properties as coal tar, with the added benefit that it can be successfully applied to an existing asphalt roof as well as a coal tar roof. This provides contractors who are entering the restoration arena with a solution for retarding the deterioration of asphalt membranes that were improperly installed on a flat or low-slope surface, resulting in exposure to ponded water or unusual environmental contaminants.

Coal tar built-up membrane in the final stages of completion.
Conclusion

Coal tar, built-up roofing systems offer building owners a variety of benefits. On a life cycle cost basis, there are few commercial roofing systems that have out-performed coal tar. In a research paper presented by Carl Cash, a noted authority in the roofing industry, he reported that only metal roofing systems, which are typically utilized on higher slopes, had an average service life longer than coal tar. Based on his research, coal tar is expected to reach a mean age of 21 years, which is the longest of any roofing system and typically is installed at a lower slope than metal roofs.

Years of service, coupled with maintenance cost, and all other factors commonly included in the life cycle equation, determine a product's life cycle cost. Pound for pound, coal tar has traditionally been more expensive than its asphalt counterpart. However, with the rising cost of asphalt and the decline in the price of coal tar, the difference in cost is getting much smaller. On the other hand, the installed cost of a coal tar system can be less than an asphalt roofing system, due to the slope requirements. Major building codes, including the new International Building Code (IBC), require 1/4”-per-foot slope for all roofing applications, except for coal tar systems, which are acceptable at 1/8”-per-foot. This can offer substantial savings, particularly in reroofing applications which may require raising curbs, increasing nailer heights, etc., to accommodate the additional slope. Most roofing suppliers require 1/4”-per-foot slope, or at least positive drainage, in order to offer warranty coverage. Due to coal tar’s inherent resistance to water, slope is not a prerequisite. Coal tar suppliers are now offering warranty coverage, which includes ponded areas, for up to 25 years.

Although coal tar has a long performance history, state-of-the-art technologies promise a variety of new roofing solutions for the future. Coal tar is alive, well, and growing. These products offer benefits that have often been overlooked in recent years. Coal tar is once again receiving well-deserved consideration by the quality and cost-conscious consumer.

References:

1 Annual Book of ASTM Standards 04.04 (D-4799).
2 Annual Book of ASTM Standards 04.04 (D-4798).

Paige Parker is an industry writer focusing on roofing products and technology. Parker has spent her entire professional career working closely with a number of leading industry consultants and contractors. With extensive knowledge of products and applications, she has authored numerous articles and case studies discussing roofing technology and the roofing industry.

PAIGE PARKER

RCI, Inc.
800-828-1902
www.rci-online.org