

# BIO-BASED ROOF COATINGS

BY GEORGE GROH

**W**orldwide, most people are looking for greener, bio-based, natural, or sustainable chemistries to replace petrochemical-based products. Natural (something that is not produced or changed artificially) is not the same as bio-based. Consider, for example, that crude oil comes from a natural source. The United States Environmental Protection Agency (EPA) states:

Green chemistry, also known as sustainable chemistry, is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances.<sup>1</sup>

Wood is an example of a green product. It can be considered sustainable if the forests are managed with new trees being planted for the harvested trees and not all of the old-growth trees taken at once.

Many paint and roof manufacturers have joined the race for bio-based technologies, researching and developing coatings from renewable raw materials. However, to be considered both renewable and feasible, the materials used must be derived from manageable bio-based resources that do not compromise coating performance.

## MOVING AWAY FROM PETROCHEMICALS

Bio-based materials are already gaining traction with rooftop coatings. The use of roof coatings derived from bio-based products will increase even more dramatically as manufacturers determine which bio-based coatings are able to deliver value and performance characteristics similar to their petroleum-based counterparts.

The United States Secretary of Agriculture, in the Farm Security and Rural Investment Act of 2002, defined the term “bio-based product” as follows:

The term “bio-based product” means a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine) or forestry materials.<sup>2</sup>

While bio-based materials can include nonfood products that come from biomass



*Photo 1 – Boiler slag, methyl soyate, postconsumer recycled tires, postconsumer recycled glass bottles, and oyster shells are some of the many bio-based materials being used for today’s next-generation roofing materials.*

(organic, nonfossil materials), they also include, but are not limited to: crops, trees, plants, algae, and marine organisms. In addition, bio-based materials may include biological waste from households, animals, and food production.

Today, in addition to roof coatings, one can find bio-based products in a wide range of applications, including

- Fine chemicals such as pharmaceuticals, cosmetics, and food additives
- Soy-based inks and flour
- Ethanol fuel
- Soy, castor, and linseed oil-based resins (polyurethane and acrylic)
- Biosolvents, cleaners, and wood-based products such as particle-board

The Federal Bio-Based Products' Preferred Procurement Program<sup>3</sup> was launched by the Farm Security and Rural Investment Act of 2002 (FSRIA). The objectives of the bio-based preference procurement program are threefold:

- The first is to increase demand for bio-based products.
- The second objective is to spur development of the industrial base through value-added agricultural processing and manufacturing in rural communities.
- The third and final objective is to enhance the nation's energy independence by substituting bio-based products for fossil-energy-based products derived from imported oil and natural gas.

Petrochemical resources are a finite resource that will progressively get more expensive as companies become more cognizant of potential environmental damages, as demonstrated by the Deepwater Horizon oil spill catastrophe.

#### ALTERNATIVE COATINGS

In addition to the obvious advantage of reducing dependence on fossil energy, many bio-based coatings contribute to overall sustainability by reducing Volatile Organic Compounds (VOC) and by being, in themselves, 100% recoverable and recyclable.

The industry has made it a priority to eliminate VOCs and Hazardous Air Pollutants (HAP) from coating formulations. Biosolvents derived from vegetable oils, plants, and starch can gradually replace petrochemical solvents in roof coatings, thereby



*Photo 2 – Only a few years ago, a cool roof coating was considered a creditable “green” material; today, unless bio-based materials have been substituted for fossil-based resources, “cool” may not be enough.*

reducing VOCs. Many bio-based products can be recovered and recycled, which will further reduce the environmental impact of coatings.

As a result, bio-based substitutions in roofing materials are expanding rapidly, including but not limited to resins, solvents, surfactants, biocides, fillers, and asphalt.

Replacing petro-chemicals with bio-based ingredients can yield the following:

- LEED<sup>4</sup> credits
- Enhanced performance
- Improved environmental life cycle
- Higher flash/boiling points
- Very low VOC and HAP emissions
- Lower toxicity
- Readily biodegradable coatings

Other important benefits include these:

- Safer and healthier for the user
- Better for the environment
- Increased national energy security
- Greater help to rural economies
- Enhanced U.S. leadership in the world economy
- Lower dependence on imported oil

#### GOVERNMENT ENDORSEMENT OF BIO-BASED SOLUTIONS

The Federal Acquisition Regulation (FAR) was amended in November 2007 to incorporate the requirements of USDA-designated bio-based products. The federal government established a purchasing pref-

erence for bio-based products using the USDA's BioPreferred<sup>SM5</sup> Program, which incorporates 33 bio-based items for preferred purchasing. Roof coatings must have a minimum of 20% bio-based content to be endorsed as bio-preferred.

Performance is dictated by the Federal Bio-Based Product Preferential Procurement Program (FB4P) as mandated by the 2002 Farm Bill Act. Bio-Based Section 9002 of the 2008 Farm Bill requires federal agencies to purchase bio-based products identified for a federal procurement preference, except as provided in FAR Part 23.404(b). In addition, Executive Order 13514, Federal Leadership in Energy, Environmental, and Economic Performance, requires that 95% of eligible new contracts and contract modifications require the use of bio-based products.

In 2011, the USDA BioPreferred program launched a new labeling initiative to identify bio-based products that are commercial or industrial products whose main ingredients are renewable plant or animal materials. Under the voluntary labeling program, bio-based product manufacturers and distributors are now able to affix a “USDA Certified Bio-based Product” label on qualifying products. The label indicates the product meets or exceeds the amount of bio-based content required for product certification.

In addition to incorporating the afore-



*Photo 3 – Modified-bitumen roofing materials may include a wide range of bio-based resources, including but not limited to post-consumer scrap from recycled tires incorporated into the roofing compound; preconsumer crushed porcelain incorporated into the filler; renewable soy-based oils, bio-based resins, or crushed sea shells substituted for petroleum-based resources in the compound; and pre-consumer recycled boiler slag used as the surfacing.*

mentioned 20% of bio-based content, roof coatings must be ENERGYSTAR®-qualified<sup>6</sup> and listed by the Cool Roof Rating Council (CRRC).<sup>7</sup>

Besides the federal government, other

agencies that recognize the benefits of using bio-based products are The Presidential Green Chemistry Challenge Awards, CleanGredients™,<sup>8</sup> and the EPA's Design for the Environment (DfE) Program.

Some of the bio-based solutions being promoted through these agencies include

- Development of energy-saving, bio-based roof coatings and insulation
- Replacement of petro-based solvents in general-purpose cleaners, adhesive/mastic removers, parts washing, and graffiti removers

With so much public and private momentum behind bio-based initiatives, it is inevitable that these technologies will continue to transform the material landscape of the roofing industry.

#### INDUSTRIAL AND COMMERCIAL INVOLVEMENT

Although petrochemical resources remain firmly entrenched in the area of fillers and coatings for roofing materials, the movement towards bio-based technologies is well under way. Fillers derived from biological sources, such as calcium carbonate from fossilized seashells, are readily available. The majority of bio-based roof coatings use soy-based polyols and resins as their backbones. Castor oil is also being used, but castor oil is imported, mainly from India, making domestically produced soy-based polyols and resins more attractive. Soy crops, which historically have been used for human and animal consumption, are being converted to commercial use in response to the increased need for biodiesel, methyl soyate, and other soy-based derivatives.

Clearly, ecological concerns have increased the need and interest in developing alternative sources for chemical feed-

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stock. The desires to become more independent with regard to feedstock and to offer a favorable environmental footprint have boosted interest in renewable sources to replace petrochemicals.

It has already been determined that resins and additives can be based on renewable resources and formulated into coatings to comply with existing and anticipated regulations. However, due to the relatively short time that bio-based products have been on the scene, the cradle-to-grave life cycle of bio-based coatings has not yet been adequately researched.

### IS BIO BETTER?

In the ideal world of marketing eco-speak, just stating that a roof coating is bio-based creates the impression that the product will be better. But there are few things less sustainable than a leaking roof when one evaluates the ecodamage resulting from tear-off and reroofing. The reality: If bio-based products do not achieve waterproofing performance at least equal to their petrochemical counterparts, whatever initial ecological advantages they provide will be quickly outweighed by the inevitable environmental damage precipitated by a failed roof.


In addition to this performance challenge, the transition to bio-based technologies by all industries continues to be impeded by

- The scalability requirements of mass production
- Necessary plant science refinements
- The complexities of varying bio-based material compositions and metabolisms

Rising to these challenges will, one hopes, lead to plants or crops that can be produced feasibly. As companies develop crop-processing methods that are economical, product use and marketing will follow. But the costs related to research and development, implementing sustainable practices, and marketing products to suit customer preferences are substantial and will require a thoughtful evaluation of the value-to-benefit ratio of bio-based alternatives.

Ironically, bio-based solvents are considered a VOC, so their environmental impact is on par with that of regular solvents. Does the reduced impact of the raw materials themselves justify substitution as a “green” investment? These are the types of dilemmas that today’s manufacturers are facing.

Another major concern, when comparing various products, is what constitutes an acceptable bio-based percentage. The USDA BioPreferred program lists roof coatings as containing a minimum of 20% bio-based materials. But from the vantage point of public acceptance, is 20% truly enough? Would 50% to 90% be a more credible threshold for making bio-based product claims, from the customer’s perspective?

In the years ahead, the market will continue to sort out concerns such as these. Meanwhile, industry-leading roofing manufacturers will continue to investigate bio-based roof coatings, paving the way for environmental, performance, and energy-saving improvements. One thing is certain: The roofing industry is making its way toward a greener future. 

### REFERENCES

1. Refer to [www.epa.gov/gcc/pubs/epa\\_gc.html](http://www.epa.gov/gcc/pubs/epa_gc.html).
2. “Accelerating the Development of the Market for Bio-based Products in Europe: Report of the Taskforce of Bio-Based Products,” composed in preparation of the communication, *A Lead Market Initiative for Europe* (COM 2007, 860 final, Brussels).
3. Refer to [www.biobased.oce.usda.gov](http://www.biobased.oce.usda.gov).
4. Leadership in Energy and Environmental Design® (LEED®) and Green Building Rating System® are registered trademarks of The U.S. Green Building Council.
5. BioPreferred™ is a registered service mark of the United States Department of Agriculture.
6. ENERGYSTAR® is a registered trademark of the U.S. government. The Energy Star program represents a voluntary partnership among businesses, organizations, and the federal government to promote energy efficiency and environmental activities.
7. The Cool Roof Rating Council is an independent and nonbiased organization that has established a system for providing building code bodies, energy service providers, architects, specifiers, property owners, and community planners with accurate radiative property data on roof surfaces that may improve the energy efficiency of buildings while positively impacting the environment.
8. CleanGredients™ is a trademark of GreenBlue®.

### George Groh

George Groh is a laboratory specialist for The Garland Company, Inc., a Cleveland-based manufacturer of waterproofing solutions for the building envelope. An experienced coatings chemist and lab manager, Groh is well versed in the formulation challenges inherent in developing cost-effective organic chemistries to solve real-world problems.



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