Investigator's Summary
Nomination 2005-30
Investigator: Douglas M. Danzig

Soy-Based Construction Materials

The Innovation

This investigation originally focused on a single soy-based polyurethane foam product called BioBase 501, which is an innovation in construction insulation.[1] However, after extensive review, it became apparent that although this particular product and other such foams are worthy of consideration on their own, there is an entire class of soy-based construction products that build upon a common soybean-based material engineering heritage. Therefore, this investigation was expanded to consider the following:

I. BioBase 501 and other such foams' worthiness for NOVA Award
II. The breadth of other soy-based construction products
III. The underlying material engineering innovation

The Jury may wish to consider whether an award is appropriate to (a) BioBase 501 and other such soy-based insulation materials or (b) the entire class of soy-based construction products noted in this investigation along with the underlying soy-based material engineering innovation, particularly those supported by the United Soybean Board (USB).

I. BioBase 501 as an Individual Product

BioBase 501 is soy-based polyurethane foam. It is an ultra-lightweight spray-on insulation foam based on soy bean oil. It is semi-rigid, open cell foam, applied in a one step spray-on application to form a sealed thermal insulating envelope. BioBase 501 is an environmentally friendly alternative to other conventionally used insulating products such as fiberglass, cellulose and petroleum based products.

BioBase 501 polyurethane insulation is in the same class as Icynene and other petroleum based polyurethane foams of half pound density. It looks very similar to petroleum based polyurethane foams except the oil base of soy origin significantly reduces its manufacturing cost.

Key advantages:

- Uses no volatile organic compounds (VOCs) or chlorofluorocarbons (CFCs)
- Provides a superior moisture / wind than fiberglass and cellulose
- Less prone to deformation than less rigid insulation types

[1] I nominated two examples of soy-based polyurethane foam for the NOVA Award: BioBase 501 and HealthySeal. Of these two, Mr. Danzig investigated only BioBase 501. However, his report on BioBase 501 is also applicable to HealthySeal and, possibly, other soy-based foam insulation products. Bob Carr

- Increasingly price competitive (particularly with petroleum based insulation)
- Inhibits mold
- Class 1 Fire Rated
- Provides Superior Soundproofing
- It is based upon a renewable resource

Thermal Performance:

BioBase 501 insulation has heat transmission (resistivity) properties similar or better than conventional fiberglass, cellulose and petroleum based products. Thermal resistivity is defined as a material's ability to resist heat flow.

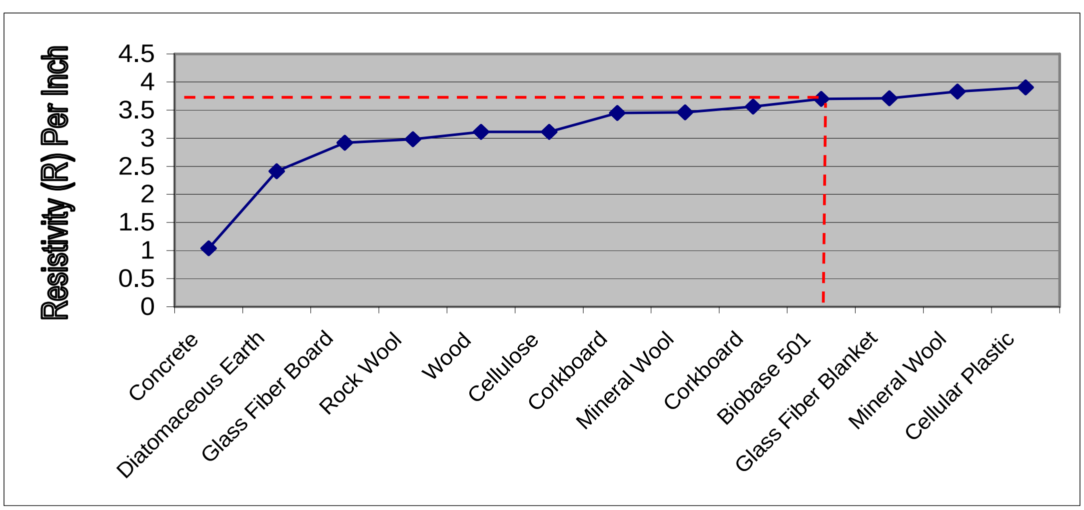
Thermal resistance (also known as R-value) is a measure of the temperature difference across a unit area of a material of unit thickness when a unit of heat energy flows through it per unit of time. It is determined by measuring that material's resistance to heat flow per square meter of its surface area given a temperature difference of 1 degree °C (= 1 °K) between both sides of the material.

Example:

If the air temperature on one side of a 10 square meter slab of expanded polystyrene (thermal resistivity = 33.33 °Km/W) 20 cm thick (the resulting R-value for the slab equals 33.33/0.2 =6.66) is at 30 °C (303.15 °K) and the air temperature on the other side of the block is at 20 °C (293.15 °K), the thermal energy that will pass through the EPS block will equal 10 * 10 / 6.66= 15.02 joules per second or 15.02 watts.

Below is a comparison of typical insulation materials and how BioBase 501 Insulation compares per inch of insulating thickness.

Results from NIST Heat Transmission Properties of Insulating and Building Materials Database



http://srdata.nist.gov/insulation/Insul_query_result10.asp
Biobase 501 Resistivityadded for illustrative purpose (not part of NIST Data Set)

Economy of Use:

As shown, BioBase 501 provides similar heat and cooling load reduction per inch of insulation as conventional insulation. However it also provides a water barrier, acoustical isolation, mold resistance and structural rigidity greater than most conventional insulating products. BioBase must therefore be evaluated not only upon the insulating material it replaces, but all wall system components it replaces as well as any savings in installation labor costs derived from a simpler form of application. Finally one must add in the incremental savings in utility costs achieved over conventional insulations in the same type/size of construction.

A comprehensive comparison of <u>long term</u> costs between walls using BioBase 501 and conventional walls in residential and light commercial applications is not available and cannot be completed within the scope of this review; however, it is possible to provide a simplified comparison factoring in only <u>initial</u> material and labor costs for a typical residential application.

Exterior Wall System (with Conventional Insulation)

Activity	Descrip	Unif	Material	Labor	Equip	OH&P	Total /SF (incl OH&P)	Per 1000 SF Ext. Wall	Typical House Ext. Enclosure (4000 SF Ext)
Wall Framing	2"x4"x 8'	SF	$ 2.12	$3.66	NA	$2.22	$ 8.00	$ 7,999	$ 31,995
Insulation	3" Fiberglass Batt (R12.4)	SF	$ 0.57	$0.34	NA	$0.25	$ 1.16	$ 1,160	$ 4,640
Accoustical	Addl. Treatment to achieve SRC 70	SF	$ 1.75	$0.30	NA	$0.55	$ 2.60	$ 2,604	$ 10,414
Sheathing	Plywood on walls 3/8"	SF	$ 0.65	$0.46	NA	$0.32	$ 1.43	$ 1,430	$ 5,720
Vapor Barrier	Housewrap	SF	$ 0.16	$0.07	NA	$0.06	$ 0.29	$ 290	$ 1,160
Exterior Siding	Mid Range Vinyl	SF	$ 1.13	$1.94	NA	$1.18	$ 4.25	$ 4,250	$ 17,000
Total			**$ 6.38**	**$6.77**	**$ -**	**$4.58**	**$ 17.73**	**$ 17,732**	**$ 70,929**

Exterior Wall System (with Spray-On Soy-Based Insulation)

Activity	Descrip	Unif	Material	Labor	Equip	OH&P	Total /SF (incl OH&P)	Per 1000 SF Ext. Wall	Typical House Ext. Enclosure (4000 SF Ext)
Wall Framing	2"x4"x 8'	SF	$ 1.91	$3.29	NA	$2.00	$ 7.20	$ 7,199	$ 28,796
Insulation	3" Spray-on Soy Oil Insulation (R11.1)	SF	$ 0.45	$0.40	$0.10	$0.26	$ 1.21	$ 1,207	$ 4,826
Accoustical	SRC 70 incl. In insulation	SF		incl. Above		$ -	$ -	$ -	$ -
Ext. Sheathing	Plywood on walls 3/8"	SF	$ 0.65	$0.46	NA	$0.32	$ 1.43	$ 1,430	$ 5,720
Vapor Barrier	Housewrap	SF	$ 0.16	$0.07	NA	$0.06	$ 0.29	$ 290	$ 1,160
Exterior Siding	Mid Range Vinyl	SF	$ 1.13	$1.94	NA	$1.18	$ 4.25	$ 4,250	$ 17,000
Total			**$ 4.29**	**$6.17**	**$0.10**	**$3.81**	**$ 14.38**	**$ 14,375**	**$ 57,502**

Assumptions:
- High density rigid insulation assist with struct rigidity (reduced framing costs 10%)
- Soy Oil Insulation requires no additional sound insulation treatment to achieve SRC 70
- Material and Installation Costs are based upon Means Cost/SF 2005
- Spray-on Soy Oil Insulation cost is based upon average vendor quotes per 1000 SF

On the basis of this simplified comparison there are still significant potential initial costs reductions that may be achieved with the use of BioBase 501 or similar products. Actual construction costs will, of course, vary depending upon design, project size and management, market factors, and project location etc…

Initial cost savings from the use of spray-on soy-based Insulations like BioBase 501, Healthy Seal and PolyOl may be as high as 10 ~ 12 % if we include the cost to achieve the same acoustical performance in a conventional wall. Without sound reduction as a requirement the cost of a conventionally insulated wall vs. a spray-on soy-based insulated wall are similar. However, the soy-based insulated wall still provides a more environmentally friendly wall construction while providing the same or better performance across a range of material qualities.

Fire Safety and Toxicity

Such conventional insulation materials as fiberglass, blown in cellulose, and petro-based foam raise certain fire safety and toxicity issues.

Cellulose: because of high flammability of news paper, cellulose insulation is typically treated with fire retardant (either ammonium sulfate or a boron compound). Installers can inhale toxic levels of boric acid as a result. Concerns have also been raised that boric acid disappears from the insulation over time, potentially reducing it's resistance to fire.

Fiberglass: has been noted as a potential carcinogen as a result of fibers being inhaled. In addition, foils and other applied backing used with fiberglass may burn and the vapor space within fiberglass provides a space where mold may collect.

Polyurethane foams (petro-based) have been around a long time; however these release volatile organic compounds that can build up particularly in airtight spaces. Past application techniques also produced ozone depleting compounds.

Soy-based foams have none of these problems. They are fire resistant without added retardants. They do not pose a threat from inhalation as fiberglass does. They emit little or no volatile organic compounds. In addition, new application techniques now allow spray-on foams to be applied without producing ozone depleting byproducts.

Comparing BioBase 501 to Fiberglass insulation

	BioBase 501	Fiberglass
Density	30 kg / m3 (Rigid)	10 kg/m3
Thermal Resistivity (R) Per inch:	3.7 (In 3.5" wall: R-13)	3.9 (in 3.5" wall R-13.6)
Water permeability:	highly impermeable @3.25", 75 Pa pressure 0.0080 good vapor barrier	highly permeable poor vapor barrier may collect mold
Noise Reduction Coefficient:	NRC 70	Nominal
Carcinogenic Risk	No	Yes (OSHA)

Comparing soy-based insulation to fiberglass points out key advantages of products such as BioBase 501. It is a denser material. It provides better resistance to water penetration and absorption. It is less prone to the collection of mold. It is non carcinogenic and provides sound attenuation far superior to fiberglass and cellulose products. In addition, although fiberglass like soy-based insulation is relatively flame resistant, fiberglass insulation is typically used with paper and / or foil backing that will burn.

LEED Credits and Environmental Friendliness

The LEEDs Score is a measure developed by the US Building Green Council (USBG) for evaluating the environmental performance and economic return of buildings. Criteria include: Site sustainability (14 points), Water Use Efficiency (5), Energy Efficiency and Water Impacts (17), Material and Resource Use Impacts (13), Indoor Environmental Quality Impacts (15) and Design Innovation (5). Total Possible Score = 69 points.

BioBase 501 provides credits in three criteria

- EA Prerequisite 2 - Minimum Energy Performance
- EA Credit 1 - Optimize Energy Performance
- MR Credit 6 - Rapidly Renewable Materials

As can be seen from the above material characteristics and LEEDs criteria, soy-based insulation has many advantages. Buildings using soy-based insulation have received as many as 14 points associated with the products environmental qualities.

Conclusions:

As an individual product BioBase 501 meets many of the criteria for NOVA award. It is <u>innovative</u> - it's use of a new underlying chemical based provides superior performance in terms of toxicology, safety and environmental friendliness. It has well tested <u>performance</u> – material characteristics from thermal resistivity to permeability to noise reduction have been rigorously tested under current ASTM standards and it has been found to meet or exceed performance characteristics of previously used insulating products. In addition, case histories of applications do not identify any known long term material defects or issues of durability and performance. Finally, it has the potential to have great <u>impact</u> on the construction industry – from a cost standpoint it will become

II. The Breadth of Soy-Based Construction Materials and Products

For decades, the soybean has been a staple of the agricultural economy. Soy-based products are now being used increasingly in construction. Soy roof coatings have been used in renovating the John G. Shedd Aquarium in Chicago, and soy elevator grease has been used in the Statute of Liberty in New York City.

Much current attention related to Soy Bean based products is centered on construction materials, especially in projects for clients with chemical sensitivities or allergies or who want better indoor air quality. Soybean-based products contain no urea/formaldehyde and, though they are processed with chemicals, they release no volatile organic chemicals (VOCs) or other toxic emissions. Some of the soy-based products now on the market include carpet backings; wood and concrete coatings and stains; adhesives; roofing; and structural membrane coatings.

Soy Oil Based Construction Products

The class of soy-based construction products is extensive. The following is a representative cross section of products that have been developed.

1. Emega Block (ICF): Soy-based alternative to concrete masonry units

http://www.emegabuild.com/foambuilding.html

Insulated concrete foam construction (ICF) uses building units shaped into blocks or panels that have cavities in their interior. The units are usually constructed from plastic foam and are assembled into the shape of a building's exterior wall. Steel reinforcing bars are place vertically and horizontally within the form, and the cavity is then filled with concrete. Unlike traditional form work that uses steel, aluminum, or plywood, ICFs are left in place after the concrete hardens.

2. Soyol (Carpet Backing, Spray Insulation, Panels, Foam): alternative to cellulose and petroleum based backing

http://www.soyol.com/media/applications.asp

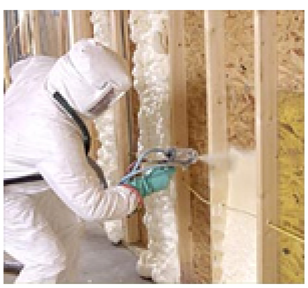
Urethane Soy Systems Company (USSC) has received pioneer US patents for the use of a new polyol, made from soybean oil, which can replace many petroleum-based polyols in the manufacture of various polyurethane plastic products including spray-on insulation, carpet backing, insulating panels and molded parts for agricultural and automotive equipment.

3. Nieman Laboratories (Soy-based Roofing): used to “jacket” bitumen base and reduce heat transmittance.

http://www.pathnet.org/sp.asp?id=7987

A Chicago-based manufacturer (Niemann Laboratories) is researching a soy-based applied roofing coating, “Natural Bitumen Jacket”, that provides relief from intense sunlight. Natural Bitumen Jacket is a bright white, soybean oil-based product that is applied over bituminous substrates on flat-roofed buildings and has a rapid cure time. By reducing the amount of energy absorbed from intense sunlight, the use of air conditioning units to offset absorbed heat is also reduced.

4. Soy-based Polyurethane Insulation & BioBase 501.



Soy-based polyurethane insulation is resistant to mold and mildew. It is sprayed on and expands in the wall to form a dense inner wall core – (0.5 Lbs/Cuft). According to the United Soybean Board (USB), soy insulation provides insulation characteristics in four-inch walls that are as good as or better than traditional batting insulations with six-inch stud construction. Soy-based insulation however, may also reduce building costs by decreasing the amount of lumber used, because the compound creates very dense and structurally rigid wall core which can help walls resist racking.

5. Soy protein hydrolyzate, EKA 3050 sold by Eka Chemicals, Inc. is currently being used for manufacturing finger-jointed dimensional lumber.

Finger-jointed lumber is made by end-gluing short pieces of wood, which would otherwise be chipped, burned for fuel or discarded. A major lumber grading agency, Western Wood Products Association has approved the soy adhesive for vertical use studs and structural lumber of all grades. It has certified one mill, to date, to use the process to make finger-jointed dimensional lumber. The lower cost soy reduces the amount of phenol-resorcinol-formaldehyde (PRF) required in the gluing process and eliminates the need for external energy for curing. The soy adhesive may be used with either dried or green wood. Use with green wood has additional economic and environmental benefits. By eliminating knots and other weak areas of wood prior to kiln-drying, kiln costs are reduced along with a reduction in Volatile Organic Compound (VOC) emissions per unit of finished lumber.

6. Environ Biocomposites™ , LLC. A manufacturer of Phenix™ produces a number of soy resin and recycled material based panel products such as Environ, Dakota Burl and BioFiber

Composite materials made of post-consumer newsprint and soy resins are produced for use as decorative building composites. With the appearance of stone and the working characteristics and cost of hard woods these composites are usable as flooring, paneling, tabletops and a variety of other uses. A value-added use of a recycled product (wastepaper) and a renewable resource (soybeans), these composite materials reduce reliance on petroleum used in adhesives for traditional composites and flooring materials, conserve wood and reduce waste production

7. Franmar Chemical. Produces a line of soy-based chemical solvents used in the construction and other industries.

Franmar produces biodegradable solvents such as BEAN•e•doo® Asphalt Cleaner, Soy Gel paint remover and EMERGE™ flooring tile and mastic remover. All these products are made from soybean oil, and are competitive in cost with traditional solvents classified as Hazardous Air Pollutants, Volatile Organic Compounds or ozone depleting chemicals. They are formulated for specific applications, are low in toxicity and volatility, biodegradable, and have a very high flash point. These soy-based products use Soy methyl esters to replace mineral spirits and other volatile, regulated solvents to clean greases and other contaminants from metal during processing and from finished metal parts. These cleaning products may additionally leave a thin film of non-toxic oils, which help to protect against corrosion.

Similar solvent, curing and coating products are produced by Soy Gold which produces a family of methyl esters including soy gold 1000, 1500 and 1100 which are general purpose solvents, which can also be used as release agents.

Conclusions:

There are a wide variety of soy-based products some with similar uses to BioBase 501 (ex. Soyol Insulation). Other products utilize soy oils and methyl esters to produce solvents, foams, adhesives and lubricants. The list is extensive and goes well beyond the cross section of products identified above. Each of these products is innovative – particularly as it relates to the use of a renewable resource replacement for previously used petro-based products. BioBase 501 appears to lead the group of insulating products from the standpoint of market exposure, usage and awards. It is harder to identify a clear leader or first use among the soy methyl ester solvent / lubricant products. As relates to these products it may be more useful to consider the material engineering innovation rather than the individual product.

III. Underlying Chemical/Material Innovation

Methyl Ester production: Soy-based Methyl Esters are made through transesterification, a chemical process in which the glycerin is removed from the vegetable oil (soybean or canola). The virgin oil is reacted at relatively low temperature (150 F) and pressure (20 psi) with an alcohol (methanol) in the presence of a catalyst (sodium or potassium hydroxide) producing glycerin and methyl esters. Products are differentiated by distillation levels, feed stock and/or the additives (anti-oxidants, surfactants, etc.) incorporated in each variation.

This basic chemical process produces methyl soyate:

$$C_3H_5(O_2CR)_3 + 3MeOH >>>> Cat. >>>> 3MeO_2CR + C_3H_5(OH)_3$$

Soy Oil Methanol MethylSoyate Glycerine

Methyl Soyate is the underlying material used in many soy-based solvents, coatings, release agents and foams described in the previous section. Methyl Soyate is a nearly colorless liquid with low water solubility. As a solvent and material base it has many advantages: It is lower in toxicity than many other conventional solvents and material bases. It has a higher flash point than other bases, and it is compatible with metals, plastics, most elastomers and other organic solvents. It therefore can be engineered into a wide variety of products.

Physical Properties

Flash Point	> 360 degrees F	ASTM D455
Specific Gravity	0.88	ASTM D 1475
VOCs	< 50g/mL	EPA Method 24, ASTM D 3960
Desity	7.3 lb/gal	ASTM D 1298
Solvency KB Value	58	ASTM D133

Current Uses of Methyl Soyate

Current uses of Methyl Soyate include: adhesive removers, paint strippers, oil spill clean up, parts cleaners, mold and form release agents, corrosion preventives, soy-bases for foams and polymers. Many of the products described in section II are based upon Methyl Soyate

Key Research

A key supporter of research into the formulation and use of Methyl Soyate is the United Soybean Board. The board represents 600,000 soybean farmers and is composed of 62 soybean farmers appointed by the U.S. Secretary of Agriculture to invest research funds. The USB manages the "soybean checkoff" which identifies and funds research. Five main target areas include adhesives, coatings and printing inks, lubricants, plastics and specialty products. In addition to Methyl Ester production of Methyl Soyate, a great deal of current research into the use of soy-based products is in the area of composites. In particular developing soy-based binder products to be used with wood and other organic composites. USB Research covers four areas:

1. Developing an improved water resistant product to replace the use of Urea Formaldehyde (UF)

2. Developing an improved waterproof product to replace Phenol-Formaldehyde (PF)

3. Developing a soy flour / methylene diisocyanate (MDI) mixture

4. Developing a soy phenol-resorcinol formaldehyde (PRF) for adhesives.

Product Development Off-shoots

The Iowa Soybean Promotion Board and the USB Soybean Checkoff are funding research into soy-based composites. Under this support, Heartland Resource Technologies (HRT) has been developed a low-cost soy adhesive denatured soy flour. It is partially hydrolyzed in a caustic environment. This enables the hydrophilic sites to be exposed, affording the resin better adhesion ability, mainly through hydrogen bonding, and better cross-linking as both the amines and hydroxyl groups are now readily accessible. The system becomes cured and non-reversible once the flour is cross-linked into the resin network

Conclusions:

Many of the current products on the market including those mentioned in Section II build upon fundamental research being supported by organizations like USB. The underlying material engineering innovation for many products is the development of Soy Methyl Ester based solvents, and bases as described above. The permutations of this process are wide and depend upon underlying feedstock and crop engineering as well as the chemical engineering process to extract and catalyze soy oil. Further research is also creating soy-based chemical replacements to advance composite materials, particularly in the wood and pulp industry. The NOVA Award Jury may wish to consider the contributions of the USB and the "Soybean Checkoff" in making these advances possible.

Key Investigation Questions / Interviews – BioBase 501

Effect upon the construction process: Does this product / class of products have a significant impact upon the construction process?

Answer: BioBase 501 and similar products will make a significant impact upon the construction process. Although the application of the product is similar mechanically to the application of cellulose insulation and petroleum based insulating foams, this class of soy oil products is unique in its environmental friendliness, ease of application and durability. As the relative cost of petroleum based products increases soy oil products may become a competitive alternative conventional insulations and other construction products based on non-renewable resources.

Proven Success: Does this product/class of products have a proven track record of success?

Answer: BioBase 501 and similar products have been used successfully in a large number of projects from residential construction to light commercial and institutional applications. BioBase 501 has been evaluated according to typical ASTM tests and evaluated by LEEDs performance criteria. The outcome of these tests and evaluations along with project data suggests the product is materially stable and meets or exceeds material performance criteria for comparative alternative insulating materials. In addition the product has been reviewed by and received awards from NAHB in 2004 as a Top Ten Product of the Year as well as an award as the National Green Building Council Product of the Year in 2003

Significant Advance: Is the product derivative of other products or does it represent a fundamental advance in construction and construction materials ?

There are many Soy Oil products on the market. It is difficult to judge whether BioBase 501 is the primary innovator in this class of products. Similar products identified in this review exist. There are many, many more listed and under development by vendors and through the Auspices of the US Soy Bean Council (USBC). It is clear, however, that BioBase 501 is at the forefront in a growing category of products and is certainly among a group of early pioneers in this class of products.

Risks: Are there any significant risks or unanswered questions regarding this class of products ?

A review of Material Safety Data Information (MSDS) does not reveal any significant material instabilities, disposal hazards, toxilogical or ecological hazards (see attached MSDS Sheet). The product also appears to perform as expected in building systems and no long term durability or health issues have been identified.

Key Conclusions Regarding this Product

Based upon this review, BioBase 501 appears to be a genuine advance in construction material with applications for residential, light commercial and industrial structures. The product has many material characteristics which recommend it over previously used products. The product appears to perform as advertised and no issues with long term performance problems are noted. I highly recommend this product for the 2005 NOVA Award.

Interview Summaries:

Company/ Institution: Bio Based Systems
Contact: Cameron Goldman, Director Public Relations/ Marketing

Summary of interview: I spoke at length with Mr. Goldman regarding the product, how it was developed, who was involved, and the project types it has been used on as well as its track record in the field. Mr. Goldman indicated that BioBase was fairly new to the spray-on insulation market, that petro-based foams have been around for a while but had never garnered a large portion of the insulation market in residential and light commercial structures (market share typically 2-3%). Since its inception BioBase 501 had itself increased that share by 1% and was continuing to make inroads as a result of its eco-friendly product. Mr. Goldman noted a number of projects that have successfully used the product:

The Heifer International Center in Little Rock (near the Clinton Library). The first phase of the Heifer International Center's development is a four-story structure that will transform a long-abandoned railroad yard in Little Rock's old warehouse district and transforming it the "green" way – by using only socially and environmentally responsible methods and materials – into a world headquarters and innovative educational center. The project will employ BioBase 501 as an exterior insulating product.


Rendering of the Heifer Center in Little Rock, AK

The use of BioBase 501 helped this project attain 14 additional LEED credits as part of its environmental evaluation.

Solar Home Decathalon: The Solar Decathlon brings 18 college and university teams from around the globe to compete to design and build houses that demonstrate the advantages of a solar lifestyle. BioBase 501 will be used in 2 out of 14 of the projects in the 2005 competition. In fall 2005, teams transport their competition solar houses to Washington, D.C., where they construct a "solar village" on the National Mall. The teams compete against each other in 10 contests that range from architecture and livability and comfort to how well the solar homes perform in providing energy for space heating and cooling, hot water, lights, and appliances. Each solar house must also power an electric car. The teams will build their houses to accomplish all this using only energy from the sun.


Students at University of Michigan and Carnegie Melon preparing for this year's Dept. Of Energy Solar Home Decathalon

David Powers Homes: BioBase 501 has also been used in many of the homes built by David Powers, one of the leading residential builders in Houston. These homes stand apart as they are built to comply with and even exceed the national Energy Star program, the most hailed energy efficiency program in the nation. Energy Star is a voluntary national program developed by the U.S. Department of Energy to help consumers identify a benchmark for energy efficient residential construction. The Energy Star program treats a home as a system. The components of windows, insulation, orientation, heating and air conditioning, and air tightness, are all evaluated, inspected and certified to meet stringent requirements set by the program. After winning the National Energy Star Partner of the Year Award in 2004, David Powers Homes continued to raise the bar by being one of the first production builders in Texas to use energy efficient insulation spray-on soy-based foam insulation.

Mr. Goldman indicated that BioBase 501 has earned a variety of awards including a 2003 NAHB award for green products and awards from Green Building in 2003 and 2004, consistently ranking within the top 100 green products. Although long term data are not available due to the newness of the product, Mr. Goldman indicated that they have seen no problems with durability or performance with the product. In fact he noted that typical energy savings using the product in homes resulted in energy bill reductions as high as 30% over conventional insulation.

Overall the interview indicated that the product has proven quite successful, there are numerous examples of successful use, and data to date do not reveal any long term problems or risks. I asked Mr. Goldman if there were key contributors to the product's development. He declined to single out a person or person(s) saying the product's success really has been a team effort and credit is shared among many persons.

Company/ Institution: National Institute of Standards Advisory Board
Contact: Jonathan Teele
Title: Senior Researcher

NIST performs evaluations of new products and materials in several industries including construction to identify performance characteristics and toxicology prior to commercial use.

I spoke with Mr. Teele at NIST regarding BioBase 501. NIST reviews product safety and performance including a wide range of construction products. We spoke in general about the merits of soy-based insulation over petro-based spray-on foams, cellulose products and fiberglass insulation. Mr. Teele indicated that the current soy-based products on the market such as BioBase 501, Healthy Seal, etc… represent an advance in materials given the general lower toxicity of the product related to VOC release. He could not comment on long term durability and noted that as with all products the quality control of application must be considered regardless of material base. Regarding energy performance, he indicated that the products appear to provide comparable heat gain/loss protection to other types of product. The exact comparison from product to product can be seen from R values which have been provided by manufacturers. Overall he did not have any reservations regarding the use of soy-based insulations and indicated that they were clearly another product worthy of consideration.

Company/ Environmental Testing and Construction Inc.
Contact: Elizabeth Jacobs
Title: Project Consultant

I spoke with Ms. Jacobs in regards to LEED review of buildings, the criteria that are considered and the relative merits of soy-based insulation. Specifically she reviewed for me what criteria BioBase 501 may touch upon in LEED scoring and the impact the product may have on an assessment of the products environmental friendliness as evaluated by the scoring system. She noted that soy-based insulation could help the project score related to Energy Efficiency, Resource Use (13 pts), and Indoor Environmental Quality. She noted that the number of points achieved depended upon the extent of use and the overall heating/cooling load calculation on the building – particularly as it relates to energy efficiency. She did note several projects where LEED scores were improved by the use of high density spray-on insulation; however, she was not specifically aware of projects using soy-based foams. She indicated that assuming the R values and permeability characteristics noted for BioBase 501, she saw no reason to doubt the claims regarding energy efficiency and reduction in utility costs noted.

References and Bibliography:

Peter Yost, “Green Building Programs – An Overview,” Building Standards, March – April 2002

Nathan Engstrom, “The Rise of Environmental Awareness in American Architecture: from Bruntland Comission to LEED,” Platform (A publication of the School of Architecture at University of Texas at Austin), Fall 2002. Available at http://www.ar.utexas.edu/csd/documents/stu-papers/engstrom-1.pdf

“Building for Sustainability: Six Scenarios “ – Comprehensive Study evaluates Life Cycle Cost of six green designs. Increases in initial capital costs are weighed against decreases in operation cost to determine NPV over 30, 60, 100 year periods. Available at http://www.packard.org/pdf/2002 Report.pdf

US Green Building Council. LEED Rating System, Version 2.1 November 2002. Available at http://www.usbgc.org/Docs/LEEDdocs/LEED_RS_v2-1.pdf

Cycle Assessment, “SETAC Press, January 1998. Addendum to Life-Cycle Impact Assessment. Available at http://www.setac.org

US Department of Energy, Office of Energy Efficiency and Renewable Energy. High Performance Buildings Database. Available at http://www.eere.energy.gov/buildings/highperformance/case_studies

ASTM “Sustainability” Subcommittee E06.71 “Performance of Buildings.” Available at http://www.astm.org,

American Institute of Architect’s Committee on the Environment (COTE) website. Available at http://www.aia.org/cote

Additional websites

http://www.soyfoam.com/
http://srdata.nist.gov/insulation/Insul_query_result10.asp
http://www.nahbrc.org/tertiaryR.asp?TrackID=&CategoryID=1782&DocumentID=3842
http://www.thesoydailyclub.com/USB/ENiemann6202002.asp
http://www.eere.energy.gov/solar_decathlon/
http://www.davidpowershomes.com/energyefficiency.aspx
http://www.eka.com/eka/
http://www.environbiocomposites.com/
http://www.franmar.com/
http://www.unitedsoybean.org/f_public.htm