OMNI TECH INTERNATIONAL, LTD.

PAINTS & COATINGS

A Market Opportunity Study Update

Prepared for the
United Soybean Board

January 2009

By: Lee Orr

U.S. PAINTS AND COATINGS MARKET STUDY

TABLE OF CONTENTS

INDEX OF TABLES

PAINTS & COATINGS INDUSTRY
MARKET OPPORTUNITY STUDY

EXECUTIVE SUMMARY

The paints and coatings industry is a well established business in the U.S. Paints and coatings have traditionally been used to protect and/or decorate almost all surfaces of wood, metal and plastic. More recently coatings are being asked to endure extreme corrosion resistance in pipelines and exhibit "smartness" such as self-cleaning, super hydrophobic water repellency and self-healing paints containing microcapsules which can fill cracks in coatings.

Traditionally, soy oils have been used to make soy alkyd resins for both interior and exterior solvent-based applications. As interest in faster drying, easier to use and clean-up water-based systems has increased, soy oils can now be used as a general additive, such as binders, co-monomers or oligimers. The use of soy oil in alkyd resins, however, has been static as shown in Table 1 below.

Table 1
Use of Soybean Oil in Alkyd Paints (Million lbs.)

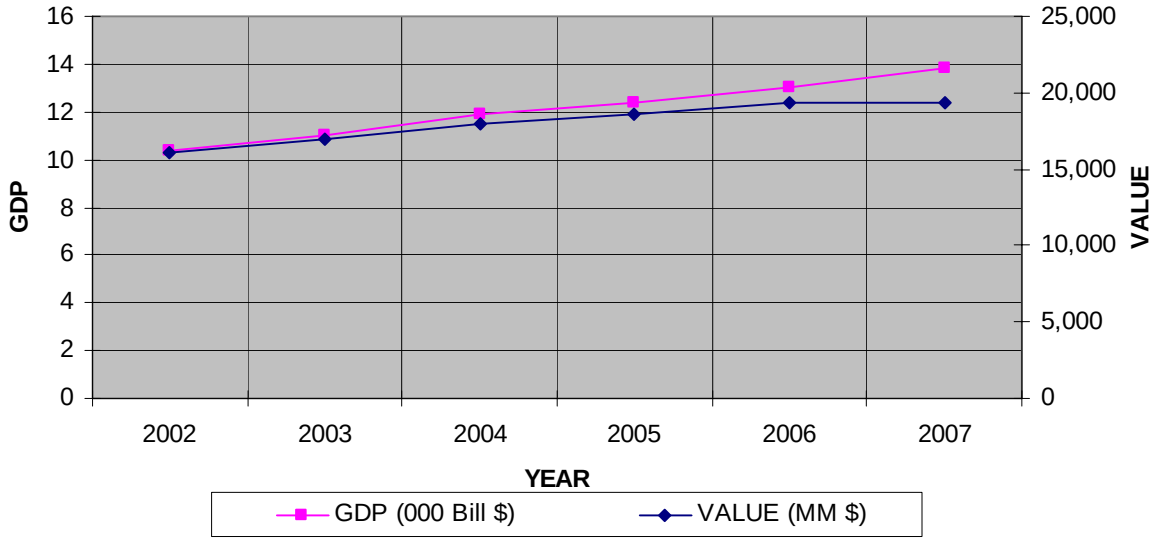
YEAR	PAINTS & VARNISH (1)	RESIN & PLASTICS (2)	TOTAL
2002	56.0	83.2	140.1
2003	70.3	89.6	159.9
2004	67.5	99.3	166.8
2005	88.6	89.8	178.4
2006	75.0	102.8	177.8
2007	35.0	145.0	180.0 (E)

1. Made by paint companies
2. Made by resin companies
3. U.S. Census Bureau – 311K Report

Another important use of soy in the paints and coatings market is soy methyl esters. These are useful as new binders and solvents in both oil and water-based systems. Their deep penetrating power into wood, concrete and other porous substrates combined with low VOCs is contributing to a growing popularity for soy in paints, stains and sealers.

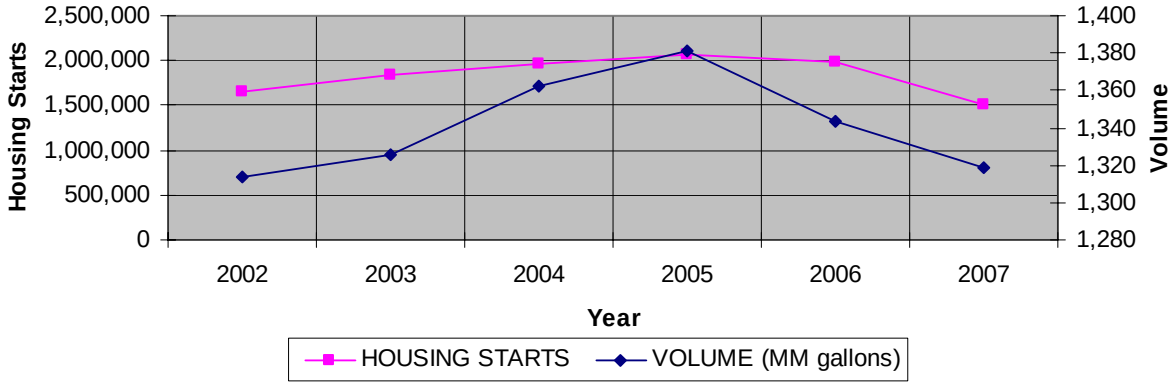
The housing and construction market has a significant impact on coatings. In the last few years, a continued cooling of these markets has adversely impacted the coatings industry. In addition, continued tightening of credit for new homes will also have a chilling effect on the housing market and subsequently the paints and coatings market. The coatings market continues to follow the Gross Domestic Product (GDP), as well as housing starts. (See Tables 2 and 3 below)

Table 2
GDP Versus Total Paints & Coatings Value (2002 – 2007)



U.S. Census Bureau – Current industrial Report – MA 325 F
Bureau of Economic Analysis

Table 3
Housing Starts Versus Total Paints & Coatings Volume (2002 – 2007)



U. S. Census Bureau, U. S. Department of Housing and Urban Development Reports

As a result of the currently very poor housing and construction markets, interest rates will probably fall to encourage lending and purchasing of the glut of homes on the market. In spite of these trends, predictions are that paints and coatings will reach long term equilibrium by the end of 2009 or the beginning of 2010. The $160 million dollar economic tax incentive provided temporary relief in the third quarter of 2008 as the GDP surged 3.2%. Shortly thereafter, the GDP declined for two quarters throwing the economy into a bad recession.

Another interesting trend in the paints and coatings industry is the rate and growth of the industry's mergers and acquisitions. Due to the industry's goals to obtain synergistic cost savings and increased market share, 2007 was a very busy year for mergers and acquisitions - approximately 24 transactions occurred in the U.S. alone versus about 14 in 2006.

By far the largest acquisition was Akzo Nobel's purchase of ICI for $16.6 billion dollars. This transaction will give Akzo Nobel about a 15% world coatings share. PPG acquired Sigma Kalon, Champion Coatings and Barloworld in 2007. The purchase of Sigma Kalon Group from Bain Chemical for approximately three billion dollars gave PPG a leading supplier position in Europe.

Sherwin-Williams made two significant changes during 2007. They purchased the $150 million dollar sales of M. A. Bruder in architectural coatings and merged the Columbia Paint and Coatings business which gives them a Northwest U.S presence. Dow Chemical made three acquisitions in 2007, including Poly Carb, GNS Technologies and UPPC in Germany. These are specialty performance coating polymer companies. In February of 2007, within its own organization, Dow established the Dow Coatings Solution Company to focus and maximize growth potential of all of its coatings chemicals. Late in 2008, Dow contracted to purchase Rohm and Haas, in part to increase its additives and resin position in the paints and coatings market.

At the 2007 American Coatings Conference in Charlotte, the National Paints and Coatings Association ranked the following technologies as to order of importance in their industry:

1. Waterborne
2. Radiation curing
3. High solids systems
4. Powder coatings
5. Conventional solvent-based systems

The United Soybean Board has actively supported projects in several of these key areas - Sherwin-Williams and Rust-Oleum in water borne technologies; PPG, Lehigh and Northampton Community College in radiation curing and Battelle-Hexion-Deere in powder coatings.

The National Paint and Coatings Association also determined the following Research and Development Drivers for the future in the paints and coatings industry in order of decreasing importance. These themes will be addressed throughout this study.

1. Legislative activity
2. Rising raw material costs
3. Customer demand for lower cost solutions
4. Higher performance products
5. Novel materials
6. Emerging markets

The most important theme within the coatings formulations industry, identified by the Dow Coatings Solution Company in a recent market research study, was sustainable raw materials. Soy, as a bio-renewable crop, represents a very promising raw material for paint and coatings formulators to reach this objective.

It is difficult to estimate the potential use of soy in paints and coatings outside the traditional use of soy in alkyd paints. While the use of soy oil to make alkyd resins in conventional solvent systems is currently static, it is still estimated to be a 180 million pound market; that equates to about 18 million bushels of soybeans. The future growth for soy will be as co-monomers in waterborne architectural finishes, binders in powder coatings and radiation cured systems, soy polyol urethanes in OEM finishes and as solvents in water and oil-based coatings and stains. These new markets are expected to use an annualized rate of 50 million pounds or 5 million bushels of soybeans in the year 2012.

OBJECTIVES

1. Update the 1998 Study in selected paints and coatings markets in light of increased emphasis on water-based, radiation cured and powder coating markets and decreased emphasis on soy-based solvent alkyd paints.

2. Revise the soybean oil potential in existing and new/emerging markets.

3. Provide recommendations for soybean oil as an additive in the coatings market.

4. Develop a short term commercialization strategy.

SITUATIONAL ANALYSIS
COATINGS OVERVIEW

In spite of the slowdown in housing and construction starts, shipment values in the paints and coatings industry in 2007 continue to match the pace of 2006 sales at around $19 billion dollars. Shipment volume, however, slipped 2% to 1,319 million gallons from 1,343 million gallons in 2006. There are 1,500 coating manufacturing facilities employing 51,000 people to meet this demand.

Table 4
Growth Rate in Total Coatings in Value & Volume (2002 – 2007)

YEAR	TOTAL COATINGS QUANTITY (MM GALLONS)	VALUE (MM $)	A.S.P. * ($)
2007	1,319	19,318	14.65
2006	1,343	19,353	14.41
2005	1,381	18,358	13.29
2004	1,362	18,017	13.23
2003	1,326	16,917	12.76
2002	1,314	16,023	12.19

Source – U.S. Census Report MA 325F
(*) A.S.P. = average selling price per gallon

As Table 4 shows, the volume of total coatings peaked in 2005 at 1,381 million gallons and has since declined by 4% to 1,319 million gallons in 2007 due to the cooling off of the housing and construction markets. On the other hand, the value of the total coatings industry has climbed from $16,023 million dollars in 2002 to its current level of $19,318 in 2007 - a 21% gain. The overall annual volume growth rate from 2002 to 2007 has been flat.

Although $19.3 billion dollars is a very small part of the total GDP, the effect of the paint and coatings industry on construction, finished products and the service industries multiplies the effect considerably. It is a major component of the construction industry, both new and repair/remodeling, and provides the employment of contractors and numerous service employees in retail stores.

MARKET SEGMENT DISCUSSIONS

Paint and coatings data are collected by the government and divided into three primary segments: architectural coatings, product coatings for original equipment manufacturers (OEM)/industrial and special purpose coatings. The miscellaneous allied paint products are not included in this study. Table 5 presents the data for each segment covering the years 2002-2007.

Table 5
Paints & Coatings by Market Segment 2002 – 2007
Quantity (million gallons) Value ($ million)

YEAR	TOTAL COATINGS		ARCHITECTURAL PAINT		Industrial/OEM		SPECIAL PURPOSE COATINGS	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
2007	1,319	19,318	768	8,966	363	5,986	198	4,462
2006	1,343	19,353	761	9,077	387	6,094	207	4,328
2005	1,381	18,538	807	9,060	410	6,032	211	4,020
2004	1,362	18,017	822	8,768	404	5,867	155	3,526
2003	1,326	16,917	785	8,326	399	5,541	165	3,369
2002	1,314	16,023	721	7,734	412	5,548	183	3,352
Average Growth Rate 2002 - 2007	Neg	4.0%	1.1%	3.1%	-2.4%	1.6%	1.6%	6.6%

Source – U.S. Census Reports MA 325F – Average Growth Rate Calculated – U.S. Census figures will be revised from time to time

Architectural Coatings in 2007 represented 46% of the total coatings value and 58% of the quantity. Architectural coatings peaked in quantity in 2004 and value in 2006. The average price per gallon shipped was $10.72 in 2002 and $11.67 in 2007.

OEM/Industrial coatings are high technology coatings used by the manufacturer of durable goods. The coatings are used both as a protective coating against the elements and as a decorative finish to enhance the appeal of the products. OEM Coatings in 2007 represented 31% of the total coatings value and 28% of shipments. OEM coatings peaked in value in 2006 and quantity in 2005. The average price per gallon in 2007 was $16.49. The per gallon value is more accurate in this segment since much of the product is shipped directly to the customer by the manufacturer with very little product going through other distribution channels.

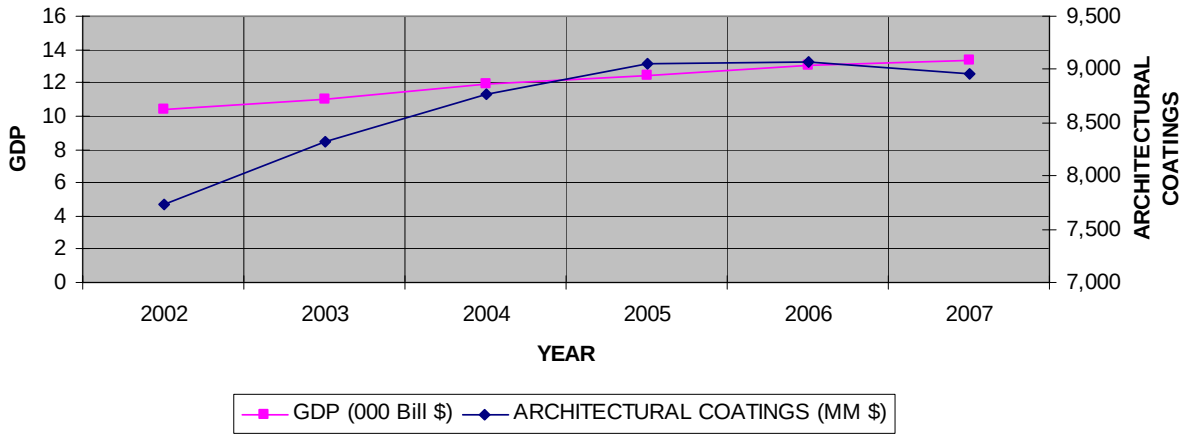
Special purpose coatings are formulated to meet the needs of specific end uses such as maintenance coatings, traffic paints, marine coatings and automobile refinish coatings. In 2007, special purpose coatings represented 23% of the total coatings value and 15% of the total volume The average price per gallon was $22.53 in 2007 versus $18.32 in 2002, reflecting the high technology required of the products, the variety of outlets the products are sold to and the small containers in which they are packaged. The average selling price has risen faster than volume growth reflecting price increase pass-through.

ARCHITECTURAL COATINGS

Architectural coatings are manufactured for application in commercial buildings and private residences. Being the largest segment in the coatings industry, the paint is used by consumers - both Do-It-Yourself and contractors in painting new houses and in the repair and remodeling markets for onsite application.

The strength of the U.S. economy has a significant impact on the demand for architectural coatings and a parallel relationship with Gross Domestic Product (GDP) .

TABLE 6
Architectural Coating Sales versus GDP



There are a number of ways of classifying architectural paints. The most common reporting manner is by interior or exterior use while another method is by water- or solvent-based systems. The Census Bureau report MQ 325F defines these coatings as follows:

INTERIOR WATER

- Flat water thinned paints and tinting bases
- Semi-gloss, eggshell, satin and other gloss water thinned paints and tinting bases
- Water thinned undercoats and primers
- Other interior water thinned coatings, stains and sealers
- Architectural lacquers

INTERIOR SOLVENT

- Flat solvent thinned wall paint and tinting bases, including mill white paints
- Gloss and quick drying enamels and other gloss solvent thinned paints and enamels
- Semi-gloss, eggshell, satin solvent thinned paints and tinting bases
- Solvent thinned undercoats and primers
- Solvent thinned stains
- Other interior solvent thinned coatings

EXTERIOR WATER

- Water thinned paints and tinting bases including barn and roof paints
- Water thinned exterior/interior deck and floor enamels
- Water thinned stains and sealers
- Other exterior water thinned coatings

EXTERIOR SOLVENT

- Solvent thinned paints and tinting bases, including barn and roof paints
- Solvent thinned undercoats and primers
- Solvent thinned clear finishes and sealers
- Solvent thinned stains, including shingle and shake
- Other exterior solvent thinned coatings, including bituminous paints

The following table shows the volume and value for these systems from the year 2002-2007.

Table 7
Volume & Value of Architectural Coatings by Market Segment 2002-2007
(Figures in Millions of Gallons and Millions of $)

	2002		2003		2004		2005		2006		2007	
MARKET SEGMENT	**Gal**	**$**	**Gal**	**$**	**Gal**	**$**	**Gal**	**$**	**Gal**	**$**	**Gal**	**$**
Interior Waterborne	413	4222	451	4511	463	4716	460	4917	441	4537	443	4819
Interior Solventborne	49	579	59	649	66	747	59	729	60	794	57	702
Exterior Waterborne	182	2032	191	2091	203	2249	199	2329	187	2356	194	2467
Exterior Solventborne	70	824	75	895	82	965	80	987	66	915	68	920
Others (lacquers)	7	79	9	90	8	91	9	98	7	75	6	58
TOTAL	721	7734	785	8236	822	8768	807	9060	761	9077	768	8966

Source – U.S. Census MA 325

Interior systems represented 62% of the total value and 65% of the total volume of architectural coatings in 2007. Waterborne systems within architectural represented 83% of the volume and 81% of the value in 2007.

It should be mentioned - in 2007 about 60% of architectural finishes were consumed by professional contractors and the rest by the Do-It-Yourselfers (DIY). The contractor is likely to use more economical interior coatings and solvent-based products on exterior applications. The DIY likely will use more expensive interior paints to avoid the labor of repainting and low odor - easier to use and clean up with water-based paints. Over 50% of architectural coatings are sold through company stores with the remaining through mass merchandisers and independent dealers such as paint dealers, hardware stores, lumber yards and decorating centers. Sherwin-Williams leads by far with the number of company stores at 3,226. The next two in size are ICI/Glidden and PPG.

Company mergers and consolidations have occurred rapidly in the last several years to the point that the top four companies represent about 65% of the total architectural market. They are Sherwin-Williams, ICI-Glidden, Benjamin Moore and Masco.

Alkyd resins, the traditional products where soybean oil are prevalent, are used in only about 20% of the architectural paint systems. The resin market for architectural coatings is provided by vinyl-acrylics with about 40% of the volume market. Acrylic and/or acrylic ester blend resins are the second most common system making up about 25% of the architectural volume. More will be discussed about resin systems in the section on Current Competitive Resins.

The role of soy-based chemistry in paints and coatings has changed. Soybean oil has long been and continues to be used as a binder in solvent/oil alkyd-based paints. Now soy oil is being combined with acrylic and acrylic esters as a co-monomer in water-based emulsions, stains and radiation cured coatings. In addition, soy methyl esters are being featured in stains and coatings as a low VOC and deep penetrating solvent. The trend towards using water-based paints for ease of cleanup and ease of use will continue to make them the fastest growing liquid paint market segment.

As seen from Table 8, Architectural Coatings quantity is expected to decline in 2008 and begin to increase slowly in 2009 and expand at a faster rate in 2010.

Table 8
Projected Volume & Value for Architectural Coatings 2007 - 2012

YEAR	QUANTITY (Million Lbs.)	VALUE ($ Millions)
2007	768	8,966
2008	691	8,428
2009	712	8,765
2010	748	9,641
2011	777	10,123
2012	800	10,730

Estimate for 2008 based upon U.S. Census Bureau data MQ 325 F through September 30, 2008. 2009-2012 projections are Omni Tech International, Ltd. estimates

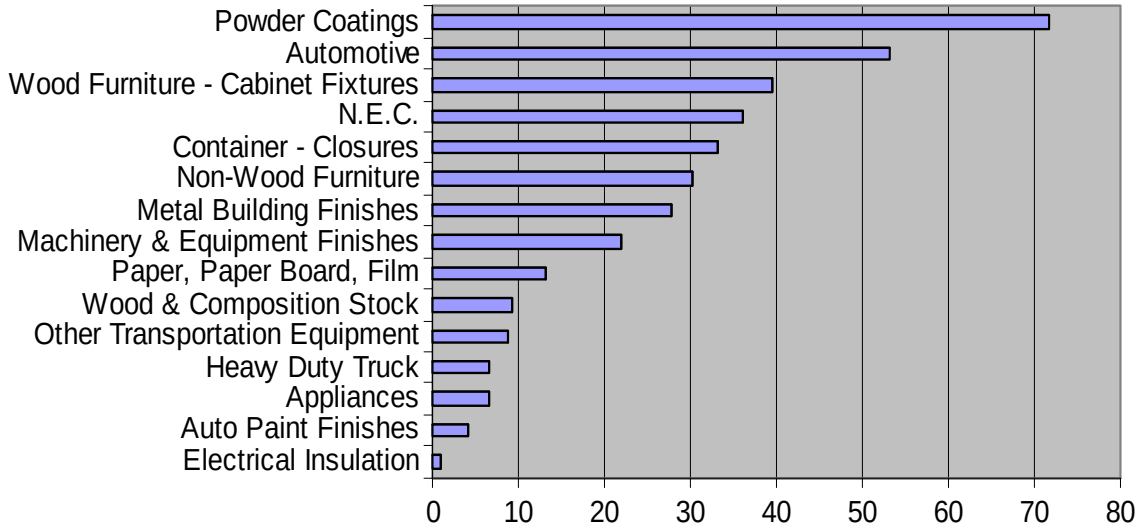
INDUSTRIAL OEM COATINGS OVERVIEW

Coatings in the industrial OEM segments are specially formulated to be applied to products during the manufacturing process. The products coated are those made of wood, metal and, in some cases, plastics. Tables 9 and 10 show the categories by decreasing volume and value. The coatings are used to provide protection of the substrate against the elements and at the same time to provide a decorative finish to the final coated product. The substrates can deteriorate if they are not adequately protected - iron and steel corrode, wood dries out and can become infested with insects and plastic becomes brittle or discolored by sunlight. The very thin paint layer forms a barrier to protect the substrate against harmful deterioration.

The thin layer of coating also provides a decorative finish which adds to the value of the product. In many products the finished coating is one of the primary selling characteristics of the product, for example, automobiles, wood furniture, appliances, etc. The coating must last over many years of product life without showing decay or lack of luster. The functional and decorative needs of the coatings require them to be highly specialized for the unique product being coated.

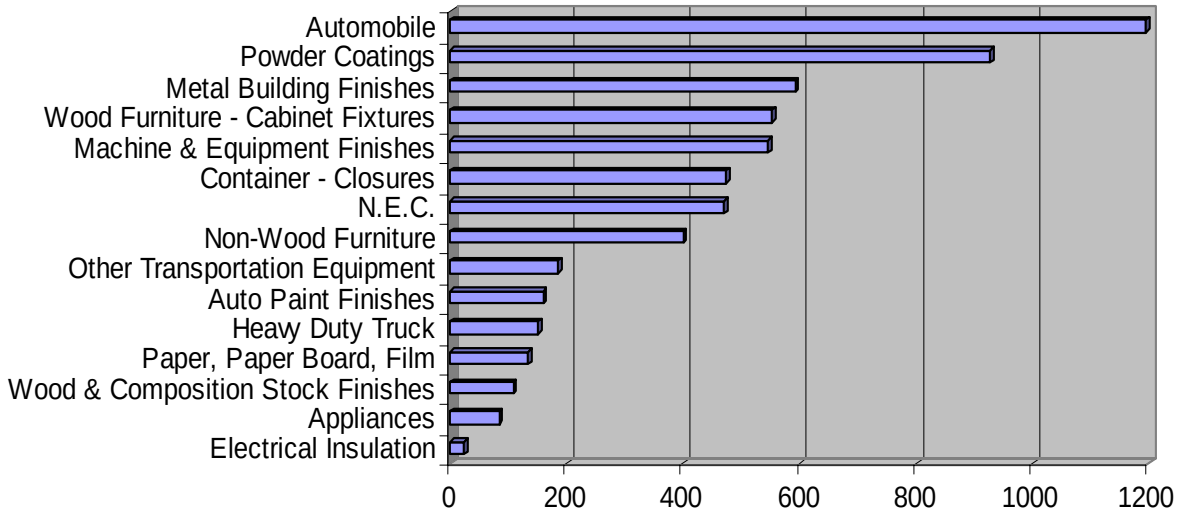
Adding to the needs for functionality and decorative qualities is the requirement to meet environmental regulations regarding their application. The main regulations are related to the release of volatile organic compounds (VOC) which are constantly being monitored and restricted at plant sites. There are other criteria which must be met such as reduced fire hazards, waste reduction and greater efficacy of coating and ease of application.

Table 9
Industrial/OEM Coatings by Quantity of Use (Million Gallons)
Total Usage 2007 – 363 Million Gallons



Source – U. S. Census Bureau MQ 325F

Table 10
Industrial/OEM Coatings by Value of Use ($ Millions)
Total Usage Value 2007 – $ 5,986 Million



Source – U.S. Census Bureau MQ 325F

In Table 11 below, the segments are broken out into the main categories as reported by the U.S. Census Bureau in their MQ 325F report and will be discussed in this order throughout the rest of the Industrial/OEM discussion.

Table 11
Industrial Coatings-OEM by Market Segment –2007
(Quantity, Value and Average Selling Price per Gallon)

SEGMENT	QUANTITY (MM gallons)	VALUE (MM $)	A.S.P. ($)
Auto, Light Truck, Van & Sport Utility	53.1	1193.9	22.48
Auto Paint Finishes	4.2	158.0	37.62
Heavy Duty Trucks	6.7	149.3	22.28
Other Transportation Equipment	8.7	183.8	21.12
Appliances	6.6	83.1	12.59
Wood Finishes – Cabinets & Fixtures	39.4	553.1	14.04
Wood & Composition Board Flat Stock	9.3	107.0	11.50
Metal Building Finishes	27.8	591.6	21.28
Containers & Closures	33.1	473.0	14.33
Machinery & Equipment Finishes	21.9	543.9	24.84
Non-Wood Furniture Finishes	30.3	399.2	13.17
Paper, Paper Board, Film	13.2	131.9	9.99
Electrical Insulation	0.9	22.7	25.22
Powder Coatings	71.7	926.8	12.92
Other Finishes (NEC)	36.1	468.6	12.98
TOTAL	363.0	5985.9	16.49

VEHICLE COATINGS

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

Auto, light truck, van, sports utility and auto parts finishes

YEAR	MM GALLONS	MM $	ASP ($)
2002	53.4	1224.0	22.92
2007	57.3	1351.9	23.59
2012	67.0	1455.0	21.71
AGR	2.5%	1.9%	-0.6%

Heavy Duty Trucks			
2002	5.3	125.0	23.6
2007	6.7	149.3	22.28
2012	6.0	133.6	22.28
AGR	1.3%	0.6%	-0.5%
TOTAL			
2002	58.7	1349.0	22.98
2007	64.0	1501.2	23.47
2012	73.0	1588.6	21.76
AGR	2.4%	1.8%	-0.5%

The vehicle category, for purposes of this report, includes finishes for autos, vans, light trucks, sport utility vehicles, heavy duty trucks, buses, trailers, campers, recreational vehicles and their component parts. Typical of the types of coatings used in this sector are electro deposition primers, surface primers, color coats, base coats and clear coats. This sector represents the second largest in volume and largest in value among the OEM categories. By far, the passenger vehicle segment represents the majority of these coatings. The major resins used in this sector include epoxies, alkyds and urethanes. Alkyd coatings represent a small portion, less than 20%, of the heavy duty truck and bus coatings. These coatings represent finishes for both plastic and metal substrates that are used on the exterior, interior and underbody of the aforementioned vehicles.

The largest suppliers - PPG, DuPont, Sherwin-Williams, Akzo Nobel and BASF – represent almost all the market share. The most important features identified by the vehicle buying public are to have a glossy and durable finish. In addition, the resin companies must provide excellent service at a reasonable cost

There is almost a direct relationship between the Gross Domestic Product of the economy and sales of vehicles. As GDP improves so does vehicle sales.
This sector has faced many regulatory and environmental issues. Vehicle coatings have retreated from traditional low solids solvents systems as a result of environmental pressures. This has resulted in advances in high solids coatings, water-based systems and powder coatings in order to eliminate solvent recovery systems and maximize painting efficiencies.

Other Transportation Equipment Coatings

Other transportation coatings include coatings for aircraft, railroad and miscellaneous vehicles - motorcycles, bicycles, etc. Major coatings include high technology urethane and epoxy systems that can withstand the abusive elements of very cold temperatures, high wind, deicing chemicals and normal air pollution. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	8.0	113.0	14.12
2007	8.7	183.8	21.12
2012	10.5	197.6	18.8
AGR	3.1%	7.5%	3.3%

Major formulators supplying this sector include Akzo Nobel, PPG, Desoto, Sherwin-Williams and ICI Glidden. Most coatings in use are high solids that are able to meet VOC emissions requirements. This development has led to the use of water-based coatings. The current economic slowdown is likely to affect the sale of transportation equipment finishes for the next few years.

Appliance Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	7.3	86.3	11.82
2007	6.6	83.1	12.59
2012	8.9	108.0	12.13
AGR	2.2%	2.5%	0.03%

Appliance coatings are specifically formulated for application to appliances such as refrigerators, freezers, washers and dryers, ranges, microwave ovens, heating equipment, water heaters, air conditioners and dehumidifiers. For the purposes of the coatings numbers in this sector, only liquid coatings are included. Powder coatings are described in another section of the report. There has been market erosion of liquid coatings due to growth of powder coatings in recent years as well as appliance manufactures using less coating per appliance.

This market is one of the smallest sectors of OEM coatings, with the exception of electrical insulation coatings. Nearly all primers such as acrylics and epoxies are applied using electro deposition coating techniques. High solids solvent polyester systems are mostly used as top coats. The low solids alkyd systems have evolved to higher solids polyester systems. Valspar and PPG have the leading role in the liquid coatings market and BASF and Akzo Nobel compete as leading suppliers in coil coatings.

Wood Furniture, Cabinet and Fixture Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	43.0	460.0	10.69
2007	39.4	553.1	14.04
2012	43.7	614.6	14.06
AGR	Neg	3.4%	3.2%

These coatings are used to finish, protect and enhance the beauty of wood products such as kitchen cabinets, televisions, radio cabinets, related bookcases and desks, musical instruments and burial caskets. This category does not include Do-It-Yourself wood stains and coatings market segment that are part of the architectural coatings segment.

Imports for furniture continue to grow and account for an increasing percentage of furniture shipments. This will negatively impact wood furniture finishes in the United States. This decline is partially offset by an increase in the domestic production of wood cabinets.

Typical coating systems include nitrocellulose solvent borne systems for furniture and for cabinets. Even with increased emphasis on low VOC coatings, the industry has been able to meet government guidelines. In addition, UV coatings are also growing. The demand for wood furniture coatings is directly driven by the housing market and the general state of the economy.

Akzo Nobel and Valspar are the leading suppliers with over 70% market share while PPG and Sherwin-Williams account for the remainder.

Wood and Composition Board Flat Stock Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	10.1	104.4	10.34
2007	9.3	107.0	11.50
2012	9.3	107.0	11.50
AGR	-0.8%	Neg	1.1%

Flat wood products are manufactured in large plants scattered throughout the United States. These products include hardboard, hardwood and softwood plywood, fiberboard, particle board and oriented strandboard. Flat stock products are used for interior paneling, exterior siding, trim board, moldings, shelving and case goods.

The finishes in this section are applied to flat stock products by the OEM. Do-It-Yourself stains and finishes are covered under both architectural coatings and furniture finishes.

Typical finishes in this sector are applied in high speed equipment where the coating must be cured quickly. Typical coatings can be prime coats, sealers and top coats. Water-based coatings are the prominent coating with radiation curing and solvent coatings accounting for the rest. Akzo Nobel, Valspar, PPG and Sherwin-Williams are the primary suppliers.

Demand for flat stock finishes will decline in 2008 and 2009 with a rebound expected in 2010. This decline and subsequent growth is related to new housing starts and reduced repair and remodeling expenditures.

Metal Building Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	35.7	542.0	15.18
2007	27.8	591.6	21.28
2012	28.0	615.0	21.96
AGR	-2.2%	1.3%	4.5%

Metal building finishes are also called coil coatings. These are coatings that take place in large automated plants where the coil is coated at speeds up to 600 feet per minute. The high speed requires a fast curing coating that has the properties needed for post-paint forming of the coil product. The finished substrates are used in appliances, automotive, general metalworking and the construction industry for such as gutters and siding.

The coil coaters and converters are most interested in appearance, durability, corrosion resistance and long term weathering. It is estimated that most of the paint used is consumed in coil coatings while the remainder is coated on sheets and strips. The trend is for limited growth in the future, as Hardie™ board cement panels and other materials such as plastics make inroads.

The coil coatings market is lead by a handful of companies including Akzo Nobel, Valspar, BASF and PPG. It is believed they represent almost 90% of the market. Coated coil is sometimes favored over traditional post-fabrication coatings because of its ability to run at very high speeds resulting in lower labor costs on a finished product per square foot basis plus transfer efficiencies and very high and scrap and repaint costs are very low.

Silicone polyesters and fluoro polymers are used for exterior construction applications due to their excellent weathering characteristics. This allows the contractor to provide 20-30 year warranties on exterior building applications. Water-based coatings are used very infrequently. Coil coaters have solvent recovery systems already installed. In

addition, water-based systems require more energy to dry and cure which is inefficient on high speed coil coaters.

Metal Container and Closure Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	43	453	10.53
2007	33	473	14.33
2012	32	500	15.63
AGR	-2.5%	1.0%	4.8%

Coatings for metal containers are applied to the interior and exterior surfaces for protective and decorative purposes. This sector includes coatings for food and beverage cans, metal drums, pails and metal closures for bottles, jars and lids.

The market continues to decline in volume due to the use of high solids coatings, the increased use of two rather than three piece cans and lower film thicknesses. In addition, plastic containers are making more inroads. The average finish will increase in cost over time, however, due to inflation and more expensive coatings like water-based epoxies and high solids coatings. On the plus side, the demand by the U.S. consumer is inelastic due to the insatiable desire of consumers for canned beverages.

Valspar and PPG are the major suppliers. Water-based coatings and high solids coatings have replaced solvent coatings, the past leaders. In addition, UV cured coatings have increased to where they represent about 10% of all coatings in this category. Beer, beverage and food cans account for the majority of coatings in this sector.

Machinery and Equipment Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	18.7	458.0	24.49
2007	21.9	543.9	24.84
2012	22.0	564.7	25.67
AGR	1.8%	2.3%	0.5%

The machinery and equipment category consists of coatings used to provide protective coatings to construction equipment, farm machinery, lawn and garden, metalworking, machine tools, electronic and scientific equipment. These applications are done in a plant environment and not in the field. Most of the liquid coatings sold to this category

are for large pieces of equipment that are hard to finish other than by spray application and air drying.

Many of the liquid coating applications are converting to powder coatings which is reflected in the minimal growth of the liquid category over the next five years.

Three companies have almost 80% of the liquid coatings market share - PPG, Sherwin-Williams and Valspar. Coatings performance is the key to success for coatings supplied by these manufacturers. The coatings are expected to survive under difficult weather, temperature and chemical extremes. The powder coatings suppliers such as Valspar, Dupont and Rohm and Haas continue to penetrate this market even as the powder coating market becomes more mature over the next five years, High solids and solventless epoxies and polyurethanes are the preferred liquid finishes.

Non-Wood Furniture, Fixture and Business Equipment Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	38.6	411.0	10.64
2007	30.3	399.2	13.17
2012	32.0	428.0	13.37
AGR	-1.7%	0.4%	2.5%

This segment covers finishes for non-wood office, institutional and home furniture, showcases, partitions, shelving, lockers, blinds and shades, computer equipment, audio and video equipment, lighting fixtures and burial caskets. The main surface that is painted is metal, but plastic can also be coated. Coil coating and powder coatings are excluded from this category. Akzo Nobel, PPG, Sherwin-Williams and Valspar lead this coatings segment with about 80% market share.

The market for these coatings tracks total construction spending, total employment and total office furniture shipments. The exclusion of powder and coil coatings keeps this segment small as both types of coatings continue to grow in this market. The market will grow at a modest 1- 2% over the next five years.

Many of the office furniture manufacturers seek LEED certification (Leadership in Energy and Environmental Design). This certification addresses the emissions from office furniture over time. This has accelerated the conversion from solvent systems to powder coatings and to bio-based products such as soy.

Paper, Paper Board, Film and Foil Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	14.0	120.0	8.57
2007	13.2	131.9	9.99
2012	13.6	152.0	11.18
AGR	Neg	2.7%	3.0%

This category includes finishes for paper, paperboard, film and foil which are formulated for use primarily in the manufacture of converted products. These coatings provide a decorative and protective finish. Examples of converted products are magazines, catalogs, labels, release liners and packaging products. Continued increases in imports along with the rising use of plastic keeps this market from growing. Generally, this sector follows the overall growth of the economy.

Water-based coatings represent the largest coating category, followed by UV curing and solvent-based coatings. Environmental concerns help the growth of UV coatings while limiting the growth of solvent-based coatings. Sun Chemical and Henkel are the leading suppliers.

Electric Insulating Coatings

Electrical insulating coatings comprise magnet wire enamels and insulation varnishes. Examples are motors, generators and transformers. The coatings provide protection against environmental conditions. Examples of end user applications are appliances, automobiles and power equipment. This category is the smallest segment of OEM coatings. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	4.4	31.9	7.25
2007	0.9	22.7	25.22
2012	1.0	23.7	23.7
AGR	-7.7%	-2.5%	32.7%

Solventborne formulations are the most prevalent, though waterborne polyesters and solventless epoxies are important. Powder coatings and radiation cured coatings are a niche, but a growing market. Among the major chemistries in use are alkyds, epoxies, polyamides, polyesters, polyester imides, and polyurethanes.
Volume in the U.S. for this sector has fallen off dramatically due to imports from China which has emerged as a low cost producer.

Powder Coatings

Powder coatings are 100 percent solid materials consisting of resins, pigments and other ingredients. Powder coatings provide a dry finish process. Powder coatings are electrostatically charged and sprayed on a grounded substrate. That substrate is most commonly metal because of the high temperatures needed to cure the coating.

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	74.1	764.9	10.32
2007	71.7	926.8	12.92
2012	76.5	937.0	12.24
AGR	0.3%	2.2%	1.9%

Lately, low temperature cured powder coatings are being used to coat thermally sensitive substrates such as plastics. The coating is applied and cured in a heating oven. Note that for the purpose of this report powder coatings are not treated as a market segment but as an alternative coating for all suitable applications.

Powder coatings have become popular because they have less than 2% volatile organic components (VOC). In addition, they are highly efficient due to their 100% solids formulation and offer very high speed cure rates at a low cost per unit. From the early years of powder coating applications, their growth rate was higher than traditional liquid coatings. The current growth rate of 1-2 % is due to industry overcapacity, product maturity and the required initial capital to convert to powder coatings from liquid coatings which has discouraged some potential users.

Powder coatings have penetrated many architectural and OEM markets. The current market volume of powder coatings in descending order is shown below:

MARKET	GALLONS MM (2007)
Other (functional thermoset & thermoplastic powders)	33.7
General Metal Finishes	19.7
Appliances	8.9
Automotive	3.7
Industrial/OEM	2.6
Architectural (siding)	1.8
Lawn & Garden	1.3
TOTAL	71.7

Source – U.S. Census Report MW 325F – Bureau converts gallons to pounds by dividing by a factor of 5

Powder coating resins may be either thermoset or thermoplastic. Thermoset resins are usually epoxies, polyesters, acrylics or hybrids of each. Polyolefins are the most popular thermoplastic resins. Ninety percent of the resins are thermoset in nature. The major thermoset resins are epoxy polyester hybrids, polyester carboxyl, polyester hydroxyl and epoxies. The major thermoplastic resins are polyvinyl chloride and nylon. Major suppliers to this market are Valspar, Rohm and Haas, Sherwin-Williams, Akzo Nobel and DuPont.

Other Industrial Finishes

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	43.0	455.0	10.58
2007	36.1	468.6	12.98
2012	34.6	420.0	12.13
AGR	-2.0%	-0.8%	1.5%

The Other Industrial Finishes category includes all OEM liquid coatings that have not been assigned to another category by the U.S. Census Bureau in its annual coatings report. This is a diverse sector as shown by a partial listing of markets:

Jewelry
Sporting goods
Dolls, toys and games
Pens and pencils
Signs
Musical instruments
Fasteners, buttons, needles and pins
Brooms, brushes, and mops

This category is forecast to decline over the next few years due to the increased use of powder coatings and increased imports of some of these products In addition, this segment is affected by the overall growth of the economy as measured by the GDP.

The major suppliers of coatings to this sector are major suppliers to OEM coatings in general such as Akzo Nobel, DuPont, PPG and Valspar. These product category finishes are subjected to the same environmental and regulatory influences discussed in other OEM segments. Water-based finishes, as well as powder coatings, are favored in this segment as opposed to solvent coatings.

INDUSTRIAL OEM MARKETS - SUMMARY

Table 12 shows the top Industrial/OEM coatings manufacturers by market segment.

Table 12
Top Industrial/OEM Coatings Manufacturers by Market Segment Participation

COMPANY	MAJOR INDUSTRIAL/OEM MARKET SEGMENTS								
	Vehicle	Appliance	Wood Finishes	Wood Composition	Metal Building	Metal Containers	Machine Equipment	Non-Wood	PC
Akzo Nobel	X	X	X	X	X			X	X
DuPont	X								X
PPG	X	X	X	X	X	X	X	X	X
Valspar		X	X	X	X	X	X	X	X
BASF	X	X			X				
SW	X		X	X			X	X	X

Source – Omni Tech International and industry sources

SPECIAL PURPOSE COATINGS

The Special Purpose Coatings segment is made up of a number of dissimilar product classifications. The coatings are primarily used to protect surfaces and designed to perform a special purpose within the domestic economy. The table below lists the different classifications that are included in this segment.

Table 13
Special Purpose Coatings by Volume and Value– 2007

CLASSIFICATION	MILLION GALLONS	$ MILLIONS	MARKET SHARE (%)	
			QUANTITY	$
Industrial Maintenance	75.1	1,215.0	38.0	27.4
Traffic Marking Paint	32.9	339.1	16.7	7.7
Automobile Refinish	60.7	2,424.6	30.7	54.5
Marine Paints	13.0	276.6	6.7	6.3
Aerosol Paints	15.4	174.4	7.8	4.0
Miscellaneous Coatings	0.9	32.3	0.1	0.1
TOTAL	198.0	4,462.0	100.0	100.0

Source – U.S. Census Bureau Report MQ 325F

Industrial Maintenance Coatings

Industrial maintenance coatings are formulated to withstand extreme conditions such as heavy abrasion, water immersion, chemicals, corrosion, extreme temperatures and electrical and solvent exposure. The maintenance coatings are used on non-residential, commercial and industrial buildings, plants, processes, bridges and tanks. The primary purpose in most applications is protection of the substrates, but decorative use is also important. Plants and buildings are judged not only by the degree of protection of the surfaces, but also by the appearance of the structures. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	58.0	786.0	13.55
2007	75.1	1215.0	16.18
2012	87.1	1251.4	14.36
AGR	5.0%	5.9%	0.6%

These systems are applied by professional applicators on site or in a fabrication facility. They are applied as part of new construction fabrication or as part of routine maintenance to provide continued asset protection from corrosion, abrasion, fungi, thermal attack and other forms of structural degradation.

Industrial maintenance coatings are sold as systems based on a combination of products selected to meet specific exposure and service conditions. The main exposure and service categories are marine, non marine, non corrosive, interior splash and spill of chemicals, immersion and thermal exposure. For these service exposure conditions there are usually three categories of coatings - *high performance* includes epoxies and polyurethane, *moderate performance* includes soy alkyds and acryllic chemistries and *light duty* includes alkyds and acrylic chemistry.

Soy alkyd resins were one of the first materials developed for this coating category and still remains popular for use. They account for less than 20% of the sales volume. They are favored for low cost protection against atmospheric corrosion and weathering.

For direct-to-customer distribution, Rust-Oleum and Akzo Nobel account for about half of the sales. As for selling through company-owned stores, Sherwin-Williams is the leading supplier with over 50% market share. Other suppliers with company owned stores include PPG and ICI. The last channel of distribution is through dealers/distributors and in this market Benjamin Moore, Rust-Oleum, Ameron and Sherwin-Williams account for more than 50% market share.

Traffic Marking Paints

The U.S. Census Bureau defines traffic paints as coatings specialty formulated to withstand wear of vehicular traffic and to be highly visible at night which used to mark center lines on roadways, traffic lanes, crosswalks, etc. and includes paint

manufactured for use with reflective beads. Generally speaking, traffic marking paint is a fast drying, highly visible, good weathering paint that is applied to highways, traffic lanes, crosswalks, parking lots and airport runways. The beads in the paint are supplied by the manufacturer or added by the applicator at the job site. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	39.0	241.0	6.18
2007	32.9	339.1	10.31
2012	36.9	383.0	10.38
AGR	-0.5%	5.9%	6.8%

Traffic paints must be application friendly, durable, day/night visible and dry for traffic quickly. Ten years ago, the soy-based solvent alkyd paints led this market with about 60% share, but now account for only 10% share. With the advent of water-based technology, vinyl acrylics and straight acrylics have grown from 10% market share ten years ago to about 85% today. The changes are due to low VOC and other environmental requirements. The industry has also moved to the use of higher solid paints from the lower solids alkyd of ten years ago.

Sherwin-Williams and Ennis account for about 75% of this market category. Ennis Paint is the largest producer of highway pavement materials.

Automotive Refinish Paints

Automobile refinish paints are the largest sector of Special Purpose Coatings in value and second in volume. Refinish paints are used primarily in the automotive industry to repair and repaint damaged auto body surfaces. The products vary from those used by body shops and dealer paint shops to the DIY spray can product. The refinish paint category also includes the refinish paints used for truck and buses, other transportation, machinery and equipment. Excluded from this category are the automotive refinish paints that are used in truck fleet OEM classifications. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	45.8	1632.0	35.63
2007	60.7	2424.6	39.94
2012	65.0	2535.0	39.00
AGR	4.2%	5.5%	0.9%

Growth in this industry is slow due to the slowing accident rate and the increase in the proportion of non-repairable vehicles.

Most coatings in this sector are high solids solvent borne coatings because of the value placed on gloss and appearance. The industry has been largely successful in

developing solvent borne products to meet regulations. The formulators supplying the U.S. automotive refinish coatings are highly concentrated and controlled by global formulators who also sell to other auto related segments of the coatings market. PPG, DuPont, Sherwin-Williams, BASF and Akzo Nobel have almost 100% market share.

Marine Paints

Marine coatings are formulated to withstand the rigors of water immersion, salt water contact and the corrosive marine atmosphere. Products for which coatings are used includes military and commercial ships, pleasure craft, off shore rigs, harbor coatings and refinish paints. Also important is the coating's ability to be applied under difficult construction and maintenance conditions and in compliance with safety, health and environmental regulations. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	13.5	251.0	18.59
2007	13.0	276.6	21.28
2012	12.3	264.0	21.46
AGR	-0.9%	0.5%	1.5%

Marine coatings are a mature market, and their value and growth will be very static. The primary driver for this market is the recreational boat industry.

The biggest issue facing this sector is the ban on TBT tributyltin) commonly used as an ingredient in anti-fouling compounds. These compounds were banned from production and sale in 2003 and their presence on hulls was banned beginning in January 2008. Copper-based compounds have emerged as the primary replacement, but will be more expensive.

The major suppliers of these coatings are Akzo Nobel, Ameron and Rust-Oleum which collectively have nearly 70% market share. Sherwin-Williams is among the minor suppliers of coating to this sector. The major chemistries in this sector are epoxies for corrosion control, durability and chemical resistance; polyurethanes for weatherability and appearance retention and some modified epoxies to enhance weather resistance and appearance.

Aerosol Paints

Aerosol paints are formulated to be sprayed from pressurized cans for the finishing of cars, metal products and numerous consumer touch-up jobs. Aerosols are also used in arts and crafts, industrial and commercial construction markets and numerous other applications. Aerosol paints are used by both the DIY and professionals with the DIY market being the largest segment representing 80% of all sales. Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	13.3	202.0	15.19
2007	15.4	174.4	11.32
2012	18.0	241.0	13.38
AGR	3.5%	1.9%	-1.2%

Alkyd paints represent about half of all aerosol paints, so environmental restrictions on these coatings will grow. The primary distribution of these products is through the mass merchandisers. Three coatings companies – Sherwin-Williams, Rust-Oleum, and Valspar - serve about 80 percent of the U.S. market.

Miscellaneous Special Purpose Coatings

Volumes, dollars and average selling prices per gallon experienced and expected in this sector are shown below:

YEAR	MM GALLONS	MM $	ASP($)
2002	3.6	53	14.72
2007	0.9	32.3	35.88
2012	0.9	25.0	27.77
AGR	-7.5%	-5.3%	8.8%

This miscellaneous sector encompasses coatings not assigned to any other special purpose coating category. This category includes, but is not limited to, tub and tile repair coatings, arts and crafts paints, swimming pool coatings, ceramic coatings and fire retardant coatings.

No company has a major share in this sector because it remains fragmented and small. There are small niche suppliers such as Testors in arts and crafts and Kelly Technical in swimming pool coatings.

Special Coatings Summary

The Special Purpose Coatings sector encompasses a number of different coatings. Consequently, the companies that market to these categories are quite diverse. Table 14 indicates the major competitors in this segment.

Table 14
Top Suppliers in the Special Purpose Coatings Markets

COMPANY	MARKET				
	MAINTENANCE	TRAFFIC	REFINISH	MARINE	AEROSOL
Sherwin-Williams	X	X	X	X	X
Akzo Nobel	X		X	X	
Rust-Oleum	X			X	X
PPG	X		X		
DuPont			X		
BASF			X		
Ameron				X	
Valspar					x

Omni Tech International and Industry estimates

EMERGING MARKETS / NOVEL TECHNOLOGIES

Within the traditional markets of architectural, OEM and special purpose coatings, there are several growing and/or emerging markets for the potential use of soy-based materials. In addition, there are two novel technologies - namely nano materials and smart coatings – for which the future of soy-based material is not known at this time.

ARCHITECTURAL COATINGS

In general, there is a growing trend to use more environmentally and consumer friendly paints which are driven by increasing Green Building Initiatives and the consumer's interest in cleaner air (low VOCs), less odor and easy to use and clean up systems. There are several examples of using soy-based chemistry to achieve these ends. One example is a soy-based reflective paint used in roof coatings to save energy consumption in commercial buildings. The use of soy in this roof coating allows the builder to earn valuable points in achieving LEED certification **(**discussed in more detail in the Regulatory and Environmental Issues Section). Also low VOC soy-based esters allow the formulation of water-based, deep penetrating coatings and stains for wood furniture and deck applications as well as concrete. These soy based products also contribute to LEED points. Rust-Oleum has begun to build a platform of new soy water-based stains and sealers to match the performance of solvent based products

while offering all the advantages of water based systems. In water-based urethane stains, soy-based polyols can replace petrochemical products in clear stains for wood and deck applications. Many other soy-based opportunities are being explored.

INDUSTRIAL/OEM COATINGS

As with Architectural paints, this coating sector is concerned with the issues of cleaner air, safer to use and faster drying finishes that can save energy. The United Soybean Board has supported in research and development of several fast curing, high solids soy-based coatings that are environmentally friendly and safer to use. Work on powder coatings has resulted in a standard cure powder coating resin to be used on agricultural implements and a low temperature powder coating resin that can save energy in the curing process or be used with some plastic materials that normally distort under standard operating temperatures. Several chemically modified soybean oil resins can be used in radiation cured systems such as ultra violet and electron beam curing. Typical substrates for these coatings are flat wood, furniture, cabinets and musical instruments.

In this electronic age, there are more and more consumer products such as cell phones and computers being built. Soy-based polyols to replace petrochemical polyols are being investigated for this fast growing market.

SPECIAL PURPOSE COATINGS

The nation's infrastructure is aging and much more money must be spent on bridges, overpasses and plant storage tanks. Better bridges equal safer and better ways to travel. There is a new family of solvent free soy alkyd resins from Reichhold and CCP that may be used in this market. They provide the low VOCs found in water-based acrylic systems along with the exterior durability and excellent adhesion of solvent-based alkyd paints.

There are hybrid coatings being developed by Sherwin-Williams that contain soybean oil coupled with acrylic and polyester resins that are water-based and contain very low VOC levels. The soybean oil as a vehicle insures very low VOC levels in this industrial maintenance paint that can be used on metal or wood.

NANO-TECHNOLOGY

The coatings industry is beginning to look at nano-technology in terms of what different chemical and physical properties are possible compared with traditional coatings. A nano particle is in the range of one nanometer (10^{-9} meters). Investigations in this small particle range are being pursued for new chemical and physical properties versus traditional coatings.

It is not clear what an aliphatic organic compound such as soybean oil can have on this technology as most work is being conducted on inorganic materials. These inorganic

materials will probably be in the form of pure metals, mixed metals and metal oxides. Some of the improved properties that the industry is looking for relate to coating hardness, corrosion protection, faster UV cure and water and dirt repellence.

SMART COATINGS

The coatings industry is seeking to provide coatings that can do more than decorate and protect the substrate upon which they have been applied. Those materials are being called smart coatings. A smart coating is one which detects and responds actively to changes in its environment in a functional and predictable manner. Systems are being investigated which can respond to changes in temperature, stress, corrosion, light, atmospheric pressure and biological growth to name just a few. Some of the most promising smart coatings are self cleaning and self healing products. Self cleaning coatings literally break down over time and remove dirt and debris. Self healing coatings are encapsulated and a scratch will release monomers and other additives from the capsules and heal cracks and fissures in the film. Not much work, if any, is being done in this area with soybean chemistry, so it is hard to determine if this represents a future opportunity. It may be that soy methyl esters could be functionalized with other coating polymers as an additive or reactive material in smart coatings.

ISSUES ANALYSIS

REGULATORY / ENVIRONMENTAL

There is a real demand for soy-based coatings to contribute to the nation's interest in reducing adverse impacts upon the environment such as odors and toxic chemicals in pursuit of cleaner air. The degree of environmental impact from the manufacture of paints and coatings is minor compared with the impact from their use. The application of paints to a surface opens a pathway to move the volatile fraction of a paint formulation from a closed container into the air. To the extent that the volatile fraction is mostly water, the effect is environmentally benign. For many applications, the basis of the formulation will unavoidably involve volatile organic compounds (VOCs). Soy oil chemistry has a history of reducing odors associated with organic solvents and acrylic resins and produces very low amounts of VOCs.

The Clean Air Act Amendments of 1990 required the EPA to identify the Maximum Achievable Control Technology that would be applicable to a variety of industrial processes. The EPA has continued to put regulatory pressures on the coatings industry. As an example the VOC levels for interior latex paints to meet these standards are 150 grams per liter for non-flat paints and 50 grams per liter for flat paints. Exterior paints are typically 200 grams per liter for non-flat and 100 grams per liter for flat paints. The USB is sponsoring development work at Sherwin-Williams to scale up the production of industrial coatings with a VOC level well below 100g/l.

FEDERAL PREFERRED PROCUREMENT PROGRAM

The Farm Security and Rural Investment Act of 2002, or Farm Bill, established the BioPreferred Program requiring government agencies to give preference to biobased products when making their purchases. The legislation directs the government - specifically the USDA - to determine whether products are biobased and to develop a labeling program identifying the product as certified by the USDA as biobased. Through a cooperative agreement with the USDA, the Iowa State University Extension Center for Industrial Research and Service in Ames, Iowa is investigating products to determine their biobased content and to set minimum standards for preferred procurement status. Government agencies do not have to buy biobased products if a product is not readily available or if it fails to meet performance standards or is prohibitively high in price. The minimum levels of biobased materials, which can include soy, have not yet be established for paints and coatings. Coatings companies are encouraged to initiate contact with Iowa State University in Ames, Iowa regarding their paints and coatings that are being formulated with the highest possible biobased content that still provides required performance.

GREEN BUILDING INITIATIVES

The use of “green building” is real and upon us in the coatings industry. It continues to grow even with the mortgage and credit crisis within the economy. According to *McGraw-Hill’s Construction 2009 Outlook*, the level of construction starts in 2009 is expected to decline seven percent to $515 billion following a 12% decline predicted for 2008. Even with the slowdown in the housing and construction industry, people want to save on light, energy, water and other utility bills. The National Paint and Coatings Association defines green building or sustainable building as the practice of creating and using healthier and more resource efficient models of construction, renovation, operation, maintenance and demolition. At the moment, green building initiatives are more prevalent in commercial rather than residential buildings. For instance, McGraw Hill predicts that by 2010 five to ten percent of new commercial construction will be designed using the principles of green building. Even with residential housing showing a 25% drop in 2007 from the 1.98 million homes built in 2006, McGraw Hill expects the residential green building market to be between $12-20 billion in 2009.

The U.S. Green Building Council has developed the LEED initiative mostly for commercial building practices. LEED stands for Leadership in Energy and Environmental Design. It was started in the U.S. The Green Building Council has started Green Globes in Canada. Both agencies evaluate buildings for environmentally sound, sustainable and low impact processes and materials that reduce the environmental impact.

In order to receive certification for LEED and Green Globes projects, points are awarded to reach different ratings levels. Some government agencies have adopted these ratings for the construction of their buildings and momentum is expanding to include many other industrial construction sites. The U.S. Green Building Council has

just launched LEED for homes in December 2007 and the initial response has been favorable. While paints and coatings play a relatively small role, one point in the LEED system can have an impact on the air we breathe.

In recent market research conducted by the Dow Coatings Solution Company, product sustainability was rated as the most important theme among industry formulators. This concern relates to the ability of coatings manufacturers to continue to source necessary raw materials in light of chemical control regulatory procedures. Global raw material and chemical hazard assessment are some of the most critical challenges to the sustainability of raw materials for coating formulators.

The Green Building Council is also entering this arena with a company called the Sustainable Products Corporation. It offers a Smart Label for companies who meet certain guidelines related to ISO, use of recycled feedstocks, use of renewable energy in its processes and many other factors. It is likely that life cycle analysis tools such as BEES (Building Environmental and Economic Sustainability – managed by NIST – National Institute of Standards and Technology) will become more important in achieving LEED points.

The Energy Star Cool Roof Program was created by the U.S. Department of Energy in conjunction with the EPA and Lawrence Berkeley Laboratories. The concept is that labels are given to coatings which mitigate the Urban Heat Island contribution of a building. Green Products Corp of Romeoville, Illinois earned this label with soy-based roof coatings with the support of the United Soybean Board.

In general, it is safe to say that consumers are asking for more information from the coatings manufacturers on the issues of health and sustainability and the definition of what constitutes a green paint. While there is no universally accepted definition, the architectural coating companies are trying to agree on this issue. Some companies are using the following definitions reported in the Wall Street Journal of March 15, 2007:

> *Green* - Describes products or materials that are renewable, recycled and low in chemical emissions or that are in any way touted to be good for the environment and/or human health.
>
> *Sustainable* - Means that the production is profitable, preserves natural resources and has a social improvement component.

Finally, there is a non-profit organization located in Washington D.C. that offers a certification process for companies to receive a Green Seal Certification Mark. Their mission is to promote environmentally sustainable coatings in the market place. There are about 16 pages of tests a coatings formulator must pass to receive what is called a GS 11 certification and be able to use the Green Seal Label on packaging and marketing of products.

BARRIERS TO ENTRY

While soybean oil is an important ingredient in paints and coating, it is not the only ingredient. In addition to resins like soybean oil, there are solid colorants (pigments), vehicles (water, solvents), binders and other additives which are used to improve the properties of the finished coating. Therefore, the soybean oil must be compatible with many paint ingredients in the final finish.

Because a typical paint and coating company formulates dozens of paints it can be risky, time consuming and expensive to change a primary ingredient like a resin or binder such as soybean oil. In addition, the formulator's customer must also evaluate the finished coating on their specific substrate which could vary from wood to dry wall, metal or plastic. The end users are wary of changing coatings which can affect the appearance or durability of their finished product. Therefore, the soybean oil must demonstrate a significant cost reduction, offer measurably superior performance or be a key factor in achieving newly established environmental and regulatory requirements.

UNMET NEEDS

In the 1950s, with the advent of soy alkyd paint systems, it was noticed that soybean oil contributed to the initial yellow tint of the paint and yellowing upon aging or oxidation. This can still be an issue in white paints if formulators try to use more than 50% soybean oil in the resin component of a paint. Some of this can be overcome with pigments, but this can be expensive and can change rheological properties.

The yellowing issue upon oxidation has been investigated by Eastern Michigan University. This issue has been attributed to the double bond linked to oxygen on the triglycerides. Eastern Michigan University has suggested the issue can be solved by making a soy fatty acid copolymer by free radical initiated polymerization which results in an acrylated soybean intermediate. In the process, the carboxylic acids in the molecule are removed so there is no need for the addition of amines for neutralization which contribute to yellowing.

Soybean oils are semi-drying oils and do not have the quicker cure rate of other vegetable oils such as linseed and tung oil. Therefore, soy use may be limited in certain coatings to less than 25% in the resin component. Work in the past at Iowa State University, to produce a conjugated soybean oil with alternating double bonds which improves reactivity, has not been economically successful. Soybean oil coatings tend to be softer when cured and don't provide the hardness and elongation of synthetic resins like acrylics, therefore limiting their use in some applications.

CURRENT SOY-BASED RESINS

SOY ALKYD RESINS

Alkyd resins were the primary resin used in the paint and coatings industries until the water-based DIY products were introduced in the 1950s for architectural usage. The consumer user friendly nature of water-based paints expanded their usage. In 1970, the Clean Air Act added encouragement to the development of other resin systems that could replace traditional alkyd resin solvent systems. The driving force of many of the developments during the last 35 years has been the reduction of VOC emissions from the workplace and the environment in general. Although alkyd resin paints were well proven and acceptable, they were replaced with lower VOC higher performing new resin systems including epoxies, polyesters, urethanes, acrylics and others with some of the new coatings costing more than traditional soy alkyds.

Soy alkyd resins are still popular today and used in a variety of applications as have been shown in the market overview. It can still be difficult to duplicate the high gloss, adhesion to metal and plastic and stain blocking abilities of solvent borne soy alkyd paints. Recently, companies such as Cook Plastics and Polymers and Reichhold have developed solvent free alkyd resins to combine the advantage of a low VOC system with the performance of the typical solvent borne coatings.

It is estimated by the U.S. Census of Manufactures in 2006 that 178 million pounds of soybean oil were used to make soy alkyd resins in the paint and coatings industry. Of this, 103 million pounds were used by resin manufacturers and 75 million pounds were used by the paint companies.

SOY-BASED URETHANES

Many paint companies such as PPG are establishing green programs to avoid the escalating costs of petrochemical resins by using vegetable oils such as soybean oil. The primary applications are in the Industrial (OEM) applications to replace petrochemical polyol in waterborne urethane dispersions and tailor-made solvent borne applications.

Rust-Oleum has begun to develop a platform of soy based polyurethanes to be used as stains and sealers. They are planning to introduce a family of user friendly water-based products to replace conventional solvent/oil systems.

SOY-BASED CO-MONOMERS AND BINDERS

Some of the more recent applications include use of soybean oil as a co-monomer or binder in aqueous paint systems. While investigating the issue of reducing yellowing upon oxidation as mentioned above under **Unmet Needs**, Eastern Michigan University has developed a soy fatty acid copolymer prepared by free radical initiated emulsion polymerization. The first step is to make an acrylated soybean-based intermediate and

then prepare a soybean acrylic latex to result in a film forming polymer which cures at ambient temperature. Since there are no carboxylic acids in the molecule, the hydrolytic stability is excellent and with low residual acid groups there is no need for the addition of amines for neutralization resulting in good dispersion and film forming. The lack of carboxylic acid groups and amine products results in lower VOCs and avoids yellowing problems in architectural paints.

Sherwin-Williams has produced a multifunctional biobased hybrid technology for industrial paints which is environmentally friendly. They have patented a way to depolymerize recycled polyethylene terephthalate using soybean fatty acid. This molecule is then repolymerized into a liquid polyester with soy sites for grafting. Acrylics are then grafted to the soy molecule by free radical polymerization and this anionic polymer is dispersed in water. The resulting industrial paint has excellent adhesion to metal and plastic with high gloss, excellent water resistance, good shelf stability and dry time equal to solvent paints while providing much lower VOCs.

Soy has also been co-reacted with polyester resins by the Battelle organization to be used in powder coatings. The objective was to replace petrochemical chemistry with biorenewable soy oil chemistry. The technology appears promising for both standard cure and low temperature cured powder coatings for use on plastics, metal and medium density fiberboard. Hexion has licensed the technology and is introducing the product to the market place through initial application at the Deere Company.

In the area of radiant cured coatings, Lehigh University and Northampton Community College have developed a UV curable soy/acrylic product for use in wood coatings and printing inks. The new soy-based polymer will be less expensive than 100% specialty acrylates with better pigment dispersion, reduced misting on the presses and less odor.

SOY METHYL ESTERS

New Century Coatings has developed a complete line of soy methyl ester-based stains, sealers and house paints. The products are popular because of their deep penetrating power into wood and concrete substrates. They offer the applicator very low VOC systems that are environmentally friendly and easy to use. The products are currently distributed by Eco Safety Products under the Eco-Procote® brand name.

CURRENT COMPETITIVE RESINS

NATURAL VEGETABLE OILS

One of the most popular drying oils used in alkyd resins other than soy oil is linseed oil, which is derived from flax seed. The two largest suppliers of linseed oil are ADM and Cargill. The major flax producing states are Minnesota, South Dakota and North Dakota. It is estimated that about 35 million pounds are used in the paint and coatings market.

Linseed oil has faster drying properties than soybean oil and, therefore, commands higher pricing. Table15 provides a historical overview of each product's pricing.

Table 15
Linseed Oil Feedstock Pricing History Versus Soybean Oil

	YEAR/CENTS PER POUND					
PRODUCT	**2003**	**2004**	**2005**	**2006**	**2007**	**CURRENT**
Soybean Oil	22	30	33	23	31	32
Linseed Oil	39	42	59	54	49	52

Work is ongoing to identify new varieties of soybeans which would yield an oil which would equal the drying properties of linseed oil and be valued at a premium to generic soybean oil.

SYNTHETIC RESINS

ARCHITECTURAL COATINGS

The primary synthetic resins used in paints and coatings are acrylic esters and vinyl acrylic copolymers. Their primary use is in architectural paints with some smaller usage in coatings and stains for wood and metal, flat stock coatings, traffic paints and OEM topcoats. These resins determine the gloss, hardness, stain resistance, block resistance (resistance to sticking to itself when cured), washability and durability of the final coating. The acrylic esters and vinyl acrylic copolymers are derived from acrylic acid and vinyl acetate. Vinyl acetate is derived from ethylene, acetic acid and oxygen. Acrylic acid is derived from acetylene, carbon monoxide and water or alcohol. Acrylic acid can also be prepared by the oxidation of propylene.

The primary resins acrylic acid and vinyl acetate remain in plentiful supply due to the weak housing and construction markets which affects demand for paints and coatings. Price increases for acrylic acid and its esters averaged between 5 and 10 percent in 2008 as petroleum feedstocks increased in cost. Even with decreased feedstock costs beginning in the fourth quarter of 2008 it appears that suppliers of these resins don't want to give up improved margins. Therefore, acrylic acid prices remain around $1.10 per pound with butyl acrylate and methyl acrylate selling for about a 5-10 cent premium over acrylic acid. On the other hand, vinyl acetate suppliers have reduced their selling prices from 65-70 cents per pound in 2008 to about 50 cents today (early 2009) reflecting the reductions in feedstock pricing.

It is estimated that almost 600 million pounds of acrylic acid were consumed for vinyl acrylic and acrylic ester monomers in paints and coatings. About 430 million pounds were consumed in exterior applications and the remainder for the interior applications. Rohm and Haas, Dow and BASF represent the largest suppliers of acrylics.

Soybean oil in the last several years has begun to penetrate the coatings market with new applications in roof coatings, stains, sealers, industrial and house paints. While soybean oil has increased in cost more than synthetic resins, it remains a good value in the 30-35 cents per pound range. Soybean oil-based paints can reduce odors associated with petrochemical-based paints, lower the Volatile Organic Component and offer green, sustainable alternatives. The issue of sustainable biorenewable raw materials has become a major thrust for coating formulators providing a significant opportunity to take advantage of the bio-sustainability and low VOC offered by soybean chemistry.

INDUSTRIAL OEM COATINGS

There are about 540 million pounds of petrochemical polyols used primarily in industrial coatings for conversion to polyurethanes. Polyurethanes are thermoset polymers based on the reaction of two chemicals - an isocyanate and an active hydrogen containing compound called a polyol. The petrochemical polyols are either a polyether polyol or polyester polyol.

Several large companies such as Cargill and Dow Chemical have developed families of soy-based polyols. In addition, there are also a number of smaller firms such as BioBased Technologies and Urethane Soy Systems that make competing soy polyols.

The major intermediate chemicals or raw materials building blocks (propylene oxide and ethylene oxide) used to produce polyurethane polyols have been experiencing run ups in cost as the price of one of their major feedstocks (crude oil) reached $140 a barrel. Prices have declined as oil has fallen to below $50.00 a barrel. Generally, petrochemical polyols and soy polyols are competitive in cost.

THERMAL AND RADIATION CURED COATINGS

The primary chemistry used in thermal and radiation cured coatings are polyesters, epoxies and acrylics. They are used as resins in powder coatings and ultra violet cured coatings. The main components of polyesters are propylene glycol, maleic anhydride and styrene. Epoxies are derived from epichlorohydren and bisphenol-A.

The primary ingredient in epoxies epichlorohydren is derived from polypropylene. With reduced costs for propylene, epoxy prices have dropped from about $1.60 per pound in 2008 to about $1.40 today (early 2009).

In 2007, approximately 360 million pounds and $927 million dollars of powder coatings were sold in the U.S., while the demand for UV cured coatings in North America was

108 million pounds valued at $505 million dollars. The primary suppliers of powder coating resins are Reichhold, DSM and Cytec. For ultraviolet cured resins, Sartomer and Ciba Geigy are major suppliers.

RECOMMENDATIONS

The following list of recommendations is offered to support the path forward in both the short and long term commercialization of soy-based coatings.

1. Continue to support product development for the use of soybean oils as co-monomers or binders in aqueous paint systems to confirm its value as a cost reductive and more environmentally friendly material.
2. Continue to support the development of new chemically modified soy oils to be used as co-binders with synthetic materials such as specialty acrylates in the formulation of radiation coatings.
3. Continue to support the development of soy polyols and soy/acrylic chemistry in architectural stains and sealers in order to match the performance of solvent systems with more environmentally friendly and easier to use and clean-up soy systems.
4. Continue to support the use of soy polyols in industrial performance chemicals to replace petrochemical-based resins on the basis of lower cost, price stability and the sustainability of soybean oil.
5. Continue to support the market development of soy-based powder coatings which eliminate the need to reclaim and handle solvents and are more environmentally friendly than solvent coatings.
6. Identify a project for solvent free soy alkyd resins in the special coatings markets to regain some of the market share lost to acrylic chemistry due to the issues related to solvent-borne soy alkyd products.
7. Identify a project to meet the customers demand for low cost coating solutions such as using soy chemistry for making raw material offsets to acrylic acid.
8. Continue the Soy Coatings TAP (Technical Advisory Panel) program as a means of broadcasting success stories about soy-based coatings and to identify new research opportunities.
9. Continue small taskforce customer meetings to discuss current and emerging technical issues.
10. Continue USB representation at the major coatings tradeshows and technical seminars such as the American Coatings Show, Coatings 2010, International Waterborne Symposium, Annual Federal Paint Society Meeting, Green Build and the International Builders Show in order to network with contacts, remain current about the interest in soy-based coatings and any regulatory/legislative/environmental issues which may impact the coatings business.

COMMERCIALIZATION STRATEGY

Soybeans will journey through many hands as they travel from the farmers to the final end user. The secret to success is to promote the performance, economic and environmental advantages that soy contributes to the entire paints and coatings value chain.

Farmers	USB, State Soybean Councils
Soybean Processors	ADM, Bunge, Cargill, DuPont, CHS, etc.
Resin Companies	Rohm and Haas, BASF, Dow, Reichhold, CCP, NCC, etc.
Formulators (paint companies)	Sherwin-Williams, PPG, ICI, Valspar, Akzo Nobel, DuPont, etc.
Retailers	Company Stores, Independent Stores, Mass Merchandisers, etc.
End Users	Professionals, DIYs

The most important strategies to pursue in maximizing soy use in the supply chain are:

1. Identify timely soy-based projects to be sponsored by the USB which address the industry's most important technology issues in waterborne technology, radiation curing, high solids systems and powder coatings.

2. Assist the industry in defining soybean's contribution to what have become the industry's most important Research and Development drivers for the future of the paints and coatings industry - regulatory issues, rising raw material costs, customer demand for low cost solutions and higher performing products.

3. Identify novel and emerging markets for soy-based coatings to allow the industry to improve and grow their product lines and margins.

4. Promote the value of sustainability as it relates to soy-based paints and coatings.

5. Display new paints and coatings containing soy-based materials at key trade shows such as The American Coating Conference, Green Build Show, The International Builders Show, etc.

6. Publicize soy-based research, development and commercial successes in industry trade journals, biobased magazines and periodicals.