What is Gilsonite?

Gilsonite, or North American Asphaltum is a natural, resinous hydrocarbon found in the Uintah Basin in northeastern Utah. This natural asphalt is similar to a hard petroleum asphalt and is often called a natural asphalt, asphaltite, uintaite, or asphaltum. Gilsonite is soluble in aromatic and aliphatic solvents, as well as petroleum asphalt. Due to its unique compatibility, gilsonite is frequently used to harden softer petroleum products. Gilsonite in mass is a shiny, black substance similar in appearance to the mineral obsidian. It is brittle and can be easily crushed into a dark brown powder.

Gilsonite is found below the earth's surface in vertical veins or seams that are generally between two and six feet in width, but can be as wide as 28 feet. The veins are nearly parallel to each other and are oriented in a northwest to southeast direction. They extend many miles in length and as deep as 1500 feet. The vein will show up on the surface as a thin outcropping and gradually widen as it goes deeper. Due to the narrow mining face, Gilsonite is mined today, much like it was 50 or 100 years ago. The primary difference is that modern miners use pneumatic chipping hammers and mechanical hoists.

History

The mineral now know as Gilsonite or North American Asphaltum was discovered in the early 1860's, but it was not until the mid-1880's that Samuel H. Gilson began to promote it as a waterproof coating for wooden pilings, as an insulation for wire cable, and as a unique varnish. Gilson's promotion of the ore was so successful that, in 1888, he and a partner formed the first company to mine and market gilsonite on a commercial scale.

Originally, Gilsonite was sold as "Selects" and "Fines"; the low softening point ore with conchoidal fracture was known as "Selects". The higher softening point ore with a pencillated structure was known as "Fines". Selects commanded a higher price than Fines because of its better purity, good solubility, and usefulness in the paint, stain, and varnish industries.

Time and technology have changed this classification system. Processing of Gilsonite now removes most of the inert contaminants and newer, more powerful, solvents make the higher softening point grades more interesting to the user. Today, Gilsonite is graded by softening point (a rough measure of solubility) and

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particle size. All grades carry a degree of quality far superior to those first small amounts of crude Gilsonite marketed in the 1880's.

Technical Information

The information in these pages is based on laboratory evaluation and field experience. It is correct to the best of our knowledge. Since use and application of our products are beyond our control, Ziegler Chemical & Mineral Corporation cannot be responsible for obtained results whether used alone or in combination with other products. Recommendations are made without warranty or guarantee and buyer assumes all risk and liability.

Gilsonite Packaging

All grades of Gilsonite are available in various types of packaging:

Bulk Truckload

One Ton Supersacks

25 kg. Plastic Bags

25 kg. Multi Wall Paper Bags

50 lb. Multi Wall Paper Bags

11 lb. Plastic Bags

10 lb. Plastic Bags

Truckload and LTL stocks are available for immediate shipment. Agents and warehouse stocks are located in principal cities throughout the world.

Paper bags are the most common form of packaging, but meltable plastic bags are gaining in popularity because of their convenience. The plastic bags can be used to reduce the dust associated with the opening of the paper bags. The whole bag can be introduced into a heated tank and dissolved without any packaging to discard.

Supersacks are reusable one ton bags suitable for high volume customers.

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All packaged material can be palletized and shrink wrapped to meet individual customer needs.

Truckload and LTL (less than truckload) quantities are available for immediate shipment from our mining facility in Bonanza, Utah, United States of America. Agents and warehouse stocks are located in principal cities throughout the world for your convenience.

Physical Properties of Gilsonite

Color in Mass	Black
Color in Streak or Powder	Brown
Softening Point	265-400 °F
Moisture Content	0.5 %
Ash Content	0.5 %
Specific Gravity @ 77°F	1.04-1.06
Hardness (Moh's Scale)	2
Penetration	0
Volatility, Weight %,	
5 Hours @ 325°F	< 2%
5 Hours @ 400°F	< 4%
5 Hours @ 500°F	< 5%
Flash Point, C.O.C.	600 °F
Acid Value	2.3
Saponification Value	5.6
Iodine Number	0

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Heat of Combustion	17,900 Btu / lb.
Heat of Fusion	9990 Btu / lb.
Specific Heat of Solid Phase	0.52 Btu / lb. / °F
Specific Heat of Liquid Phase	0.61 Btu / lb. / °F
Glass Transition Temperature, T_g	185-225 °F
Bulk Density, Lump	40 lbs. / ft^3
Electrical Resistivity	4.0 x 10^{12} ohm-cm
Viscosity, Brookfield	55,000 cps
@ 375°F	22,800 cps
@ 400°F	6,600 cps
@ 425°F	2,800 cps
@ 450°F	

Chemical Properties of Gilsonite

Gilsonite is included in a class of solid bitumens known as asphaltites. Gilsonite deposits are located in eastern Utah in the United States. They are different from other asphaltites because of their:

- high asphaltene content
- high solubility in organic solvents
- high purity and consistent properties
- high molecular weight
- high nitrogen content

Gilsonite is available in different grades categorized by softening point. Softening point is used as an approximate guide to melt viscosity and behavior in solution.

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The chemical differences are small between Gilsonite grades, with only subtle variations in average molecular weight and asphaltene/resin-oil ratios.

The precursor of Gilsonite is believed to be kerogen from the Green River formation deep below the Uintah Basin in eastern Utah. Mild thermal reductive degradation of this kerogen and subsequent fractionation as it was geologically squeezed to the surface are believed to be responsible for the formation of the unique deposits we mine today.

Elemental Analysis:

	Weight %
Carbon	84.9
Hydrogen	10.0
Nitrogen	3.3
Sulfur	0.3
Oxygen	1.4
Trace elements	0.1
	100.0
Aliphatic carbon	68.3
Aromatic carbon	31.7
H/C atomic ratio	1.42

Proximate Analysis:

	Weight %
Volatile matter	84.5
Fixed carbon	15.0
Ash	0.5
	100.0

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Molecular Structure:

A variety of sophisticated analytical tests have been run on Gilsonite from the Uintah Basin to characterize its unique properties. For reference, the test methods include vacuum thermal gravimetric analysis (TGA), nuclear magnetic resonance (NMR), Fourier transform infrared spectrometry (FTIR), vapor pressure osometry (VPO), high performance liquid chromatography (HPLC), rapid capillary gas chromatography (RCAP), and several fractionation techniques. H/C ratios and NMR analysis indicate the presence of a significant aromatic fraction. Most of the aromatics exist in stable, conjugated systems, probably porphyrin-like structures that relate to the geologic source of the product. The remainder of the product consists of long, paraffinic chains.

	Softening Point, °F			
Typical Component Analysis	290	320	350	375
Asphaltenes	57	66	71	76
Resins (Maltenes)	37	30	27	21
Oils	6	4	2	3
	100	100	100	100

A very unique feature of Gilsonite is its high nitrogen content, which is present mainly as pyrrole, pyridine, and amide functional groups. Phenolic and carbonyl groups are also present. The low oxygen content relative to nitrogen suggests that much of the nitrogen has basic functionality. This probably accounts for Gilsonite's special surface wetting properties and resistance to free radical oxidation.

The average molecular weight of Gilsonite is about 3000. This is very high relative to other asphalt products and to most synthetic resins. This may relate to Gilsonite's "semi-polymeric" behavior when used as a modifying resin in polymeric and elastomeric systems. There is some reactive potential in Gilsonite. Crosslinking and addition type reactions have been observed. Gilsonite is known to react with formaldehyde compounds under certain conditions.

Gilsonite Compatibility

Gilsonite is compatible with Microcrystalline and Paraffin Waxes, Petroleum Resins and Oils, Rosins, Tall Oil Pitch, Vegetable Oils (Linseed, Soya, etc.), Petroleum Process Oils, and Petroleum Asphalts.

Compatibility With Commercial Resins

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The following is a general guide to the compatibility of Gilsonite resin in common film-forming and elastomeric systems. Because Gilsonite compatibility can be influenced by variations within a resin/elastomer class and by other components in a formulation, it is good practice to verify Gilsonite compatibility in the specific formula of interest.

Adhesive/Coating Systems	**General Compatibility of Gilsonite**
Natural:	
Natural rubber	FAIR
Cellulose esters	POOR
Thermoset:	
Phenolic	GOOD
Resorcinol formaldehyde	FAIR
Urea formaldehyde	GOOD
Melamine formaldehyde	GOOD
Alkyd	GOOD
Epoxy	FAIR
Polyurethane	FAIR
Acrylic	FAIR
Unsaturated polyester	FAIR
Polyaromatic	GOOD
Acrylic acid diester	POOR
Thermoplastic:	
Polyvinyl acetate	FAIR
Polyvinyl alcohol	FAIR
Polyvinyl chloride	GOOD
Acrylic	FAIR
Polyamide	POOR
Phenoxy	POOR
Ethylene/vinyl acetate	GOOD
Elastomeric:	

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SBS rubber	EXCELLENT
Polychloroprene rubber	EXCELLENT
Nitrile rubber	FAIR
Butyl rubber/polyisobutylene	GOOD
Silicone	GOOD
Polyurethane	FAIR
Vinyl ethers	GOOD

<u>Ink/Paint Systems:</u>

Resinates	GOOD
Hydrocarbon resins:	
Rosin modified	EXCELLENT
C9 aromatic	GOOD
DCPD	EXCELLENT
Terpene	EXCELLENT
Terpene phenolic	GOOD
Rosin esters:	
Phenolic modified	GOOD
maleic-fumaric modified	EXCELLENT
Alkyd	GOOD
Shellac	POOR

Gilsonite Solubility

CHEMICAL GROUP	ITEM	SOLUBILITY
Aliphatic Hydrocarbons	VM&P Naphtha	S
	Mineral Spirits	S
	Solvents with KB Values of 30 or more	S
Aromatic Hydrocarbons	All	S
Alcohols	All	I

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Chlorinated Hydrocarbons	All	S
Esters	Methyl Acetate	I
	Ethyl Acetate	Slight
	n-Butyl Acetate	Slight
Glycols	All	I
Glycol Ethers	All	I
Glycol Ether Esters	All	I
Ketones	Acetone	I
	MEK	I
	MIBK	I
Other Solvents	Carbon Disulfide	S
	Carbon Tetrachloride	S

S=Soluble I=Insoluble Slight=Slightly Soluble

Gilsonite Solutions

Gilsonite is an important component of today's printing inks, paints & industrial coatings. Gilsonite is used as a hard resin and carbon black dispersant in a variety of coatings. Solutions of Gilsonite (sometimes called cutbacks or varnishes) are an excellent starting point for blending Gilsonite with other components of a final product formulation. Some formulators convert dry Gilsonite into liquid solution in their own facilities. Others will request a pre-made solution. Both are available from Ziegler Chemical & Mineral Corp.

Converting dry, granular Gilsonite to a liquid solution also provides the opportunity to remove the small amount of abrasive grit that occurs in natural asphaltums. Stabilizing additives can also be added if a poor solvent is used or if high concentrations of Gilsonite are desired.

Solubility:

Gilsonite is soluble in aliphatic, aromatic and chlorinated hydrocarbon solvents. It has limited solubility in most ketones, but is soluble in mixed aromatic solvents that contain a ketone component. Gilsonite is not soluble in water, alcohols, or acetone.

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Solution Preparation:

Three basic procedures are used to dissolve Gilsonite. In each case, precautions for flammable materials should be used.

Cold-cutting: Gilsonite is generally soluble in aliphatic and aromatic solvents at ambient temperatures. Some agitation should be used. The rate of solution will depend on the type of solvent, the type and severity of mixing, and the grade of Gilsonite. The solution rate can be increased by using a high shear mixer, such as a Cowles disperser. When a ball mill or a paddle mixer is used, lump grade Gilsonite is recommended. When high energy mixing is available, either lump or pulverized grades may be used. Care must be taken to avoid "dry balls" of undissolved solid when using pulverized grades.

Hot-cutting: The rate of solution can be increased by heating. Steam coils or hot oil is preferred. Direct-fired heating can be hazardous. Care must be taken to avoid or make up for vaporized solvent. Facilities for solvent containment are often necessary. The maximum processing temperature will depend on the boiling range of the solvent.

Hot fluxing: Gilsonite can be hot fluxed into asphalts and high boiling oils. Once blended, the combination can then be let down with a solvent to reach the desired viscosity. This hot fluxing with another product can help overcome limitations of solubility. Selecting the correct blend or co-solvent can yield compatibility with a solvent that is normally of limited solubility.

Hot Fluxing Procedure:

Heat the oil to 200°F or more. Most of the high boiling, low aromatic ink oils in use today will require a temperature of at least 300-330°F. With good agitation, add dry Gilsonite at a rate that maintains constant dispersion of the particles until they dissolve. Be alert for foaming that can be caused by traces of moisture in the Gilsonite. Continue to agitate for 15 to 30 minutes beyond the point when the last of the Gilsonite particles is detected. The Gilsonite should now be completely dissolved and the solution ready for discharge.

Filtration:

The varnish must be filtered to remove the grit that is a natural component of Gilsonite. There are two common filtration methods. Each provides a different degree of cleanliness. Both methods are normally preceded by passing the hot varnish through a course wire screen (approx. 1/4") to remove any large stones.

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For a normal degree of cleanliness, the prescreened, hot varnish is passed through wire screen baskets of about 200 mesh (74 microns). Cloth bag filters can also be used, at a higher cost, when the company doesn't have the personnel to clean the wire baskets. Disposal of the bags is also a consideration. Be careful to use bags that can tolerate elevated temperatures if hot cutting is performed.

For extra cleanliness, the prescreened, hot varnish is passed through cartridge filters of about 5 to 25 microns. These filters are also disposable.

Viscosity Modification:

Some Gilsonite solutions can be quite viscous at ambient temperature. Also, some solutions can steadily increase in viscosity over time. These characteristics are usually observed when using low aromatic oils with poor solvent power or when high percentages of Gilsonite are used. In these cases, small amounts of viscosity modifiers are often added to (1) keep the hot varnish sufficiently fluid for easy filtration and (2) to reduce and stabilize the ambient viscosity so the solution remains fluid until it is used.

The following is a partial list of modifiers that are effective at stabilizing the viscosity of Gilsonite solutions.

1. Soft asphalt flux. This is often substituted for 15 to 20 % of the Gilsonite in the varnish. At this level, it reduces the softening point of the Gilsonite by about 30°F. It should not be used when maximum hardness and rub resistance is desired, or when fast solvent release is required, or when restrictive health safety regulations are in effect.

2. Tridecyl alcohol (TDA). More volatile than some modifiers (a flash point of 180°F), but effective. Generally used at 3-10%, based on the Gilsonite content.

3. Low molecular weight alcohols. Examples are n-propanol and n-butanol. These are effective, but their high volatility usually restricts their use to fast drying systems or products that are stored and used at ambient temperature.

4. Tall oil fatty acids. These are mainly oleic and linoleic acids with small amounts of rosin acids present. They are used for their high flash point and low volatility. In some cases, stearic or oleic acid, or vegetable oils such as linseed or soya bean oil, can be substituted for tall oil fatty acids with comparable performance.

5. Surfactants. A wide variety of commercial surfactants are also effective. Care must be taken to avoid any undesirable side effects on the performance of the final product.

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Gilsonite is safe to use!

Gilsonite has excellent health safety characteristics. In fact, Gilsonite products are approved by the U.S. Food and Drug Administration for use in resinous and polymeric coatings that come into direct contact with food. Gilsonite falls under Section §175.300 (formerly Section §121.2514) of the FDA regulations, Part 3, subpart (iv), which lists Gilsonite as one of several approved natural resins. Gilsonite products are non- carcinogenic, non-mutagenic, and non-toxic. Details can be found in the OSHA Materials Safety Data Sheets for Gilsonite products.

Health safety has become a most important factor in the selection of resinous products. More restrictive regulations Worldwide now make it necessary to label products that contain resins with poor or marginal health safety properties. Certain resins and bituminous fractions that are derived from petroleum and coal now can only be used with proper hazard labeling. Gilsonite is a valuable, no-label, alternative to these hazardous products.

Gilsonite in its unaltered state is non-carcinogenic, non- mutagenic, and non-toxic by recognized test procedures, which include the modified Ames assay test, chronic feeding studies for the National Toxicology Program (NTP), and NIOSH protocols. It has also been documented by the State of Utah that long-term exposure to Gilsonite, especially dust, does not contribute to dermatitis, lung disease, or any other disease. However, it is recommended that dust masks or respirators be used in long-term exposure situations.

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