

ASPHALT

WHAT ?

Asphalt is the inflammable substance we use to day to surface our roads and roof our homes. But it is much more than that, especially to the ancients. It was their glue, their means of waterproofing, and occasionally their method of making a living. It was a valuable commodity, found in only a few places, and used for many different purposes. Today it is an end-product produced in the refining of oil for gasoline and heating oil. It is so common and cheap that we use it by the ton in road surfacing.

Asphalt, or better, bitumen, was found in ancient times in pools or on the surface of water, having seeped up from the formations below. It was a natural resource, collected or mined for use and export. And every source was distinct in its properties although for the most part the chemical composition was the same. The difference between hard asphalt on one hand and oil which would pour on the other, is due to the amount of entrained volatile gases.

When oil seeps out to the surface, the entrained gases slowly escape, making the asphalt left behind more viscous [thicker]. Some oil reaches the surface already thick, while other sources are quite thin and fluid. Oil in pools tends to be thicker than oil found on the surface of water. Many, many variables determine the thickness of the asphalt, and many are under our direct control. Mixing asphalt with clay or aggregate makes it much thicker. And heating will drive off the volatiles quicker while making the asphalt more fluid, temporarily.

Pitch, slime, bitumen, all are variations of the same resource, but vary according to the use. And the use depends upon the asphalt's viscosity. Slime, being very fluid, would be 'painted' on a surface for waterproofing, while pitch, thicker, would be stuffed into cracks to stop leaks. The whole point here is that there is no real definition of the various terms used when talking about asphalt. The Bible mentions pitch and slime in the same sentence implying two different substances where what is really meant is two different uses.

The best definition I can offer is:

Asphalt: a black or dark brown organic material which melts readily with heat and then flows easily. With exposure to the air or impurities the material becomes solid, to the point of hard, with a conchoidal fracture. It's composition varies widely but is basically a hydrocarbon chain of molecules. Asphalt is the product of immense amounts of time, heat, and pressure acting on the remains of organic material buried deep within the earth. Eventually this material seeps to the surface and is collected in pools where it is collected for man's use.

There are several large lakes of natural asphalt which over time have hardened into a false-appearing surface. Animals ventured out on these lakes, then have broken through the surface to become trapped and entrained. This is today a bone-pit from where the paleontologists extract and reconstruct animals long since extinct. The asphalt in these lakes have as much as 35% entrained clay and other impurities.

Inflammability

Pure asphalt flows readily when heated, becoming more viscous with higher impurity percentage. But in the process of heating, the volatiles are driven off, and these gases are very flammable. This is probably the source of the belief that a fire fueled with pitch would be a terrible judgement for the sinner. In ancient times, after the volatiles were driven off, the asphalt would then be much thicker and could no longer be used as 'slime'. It would require heating before application.

The point is, they had no solvent which could be mixed with asphalt to make it thinner. Today we can mix gasoline with it to return the volatiles, and the asphalt would pour like water. Also, the ancients considered staining with asphalt to be an unclean condition, to be avoided. Workers in asphalt were most likely shunned, due to the smell as well as the unclean aspect. Remember, they had no solvent to wash it off.

SOURCES

As mentioned before, there are several locations around the world where oil seeps to the surface, but only the more important ones around the Mediterranean will be covered here.

Dead Sea

The collection of asphalt from the surface of the Dead Sea was a major economic resource for the city of Jericho, near the north end. The asphalt rises to the surface as clumps or masses, which are then collected. Along with salts and a little sulphur, the Dead Sea was exploited from the earliest times. The supply of asphalt was so well known that the Romans called it *Lacus Asphaltites*.

In the Bible the asphalt pits in the Dead Sea valley [vale of Siddom] are mentioned, and was a major source of asphalt material for the Hebrews and Arabs.

Is River, near Hit

About 150 miles to the northwest from Babylon are wells from which asphalt was extracted. This was on a tributary of the Euphrates River, the Is, near the modern city of Hit in Iraq. The wells or springs were mentioned by Herodotus and were known as the Fountains of Is. There are also a few asphalt springs near the ancient city of Asshur, across the plateau, near the Tigris river.

This asphalt was used to cement the brickwork around the city of Babylon and to waterproof a type of round boat called a Guffa.

Zante

Another site from which asphalt was obtained was the Greek island of Zante, near the city of Keri. The oil seeps up through small pools of water and is collected when enough has solidified for use. The underlying strata is fractured limestone and clays beds through which the oil seeps. There is also a small amount of sulphur brought up, indicating a volcanic origin.

Asphalt is not associated directly with volcanic activity, but the associated earth movements often cause the fractures which allow the oil to escape to the surface. Asphalt is native to sedimentary formations, not igneous formations.

Other sites away from the Mediterranean area:

While out of my study area, there are several very large or famous asphalt lakes or tar pits which should at least be mentioned. More information can be found by searching the internet for the key words:

- The Pitch Lake on the island of Trinidad in the British West Indies covers an area of 144 acres;
- Lake Maricaibo in Venezuela was disgusting and frightful to see, but is now a large oilfield;
- The La Brea tar pits in California has been made famous for the bones of extinct animals;
- For size, nothing comes close to the Athabaskan tar sands of Canada, although underground;
- Finally, a mineral called Gilsonite is mined in Utah near Duchesne. It is an ancient and pure form of asphalt which has the look and feel of coal until melted.

USES

The uses for asphalt in it's various forms are extensive and limited only by the imagination. A few of the more common uses from the ancient literature are here listed:

Marine

Asphalt is an excellent waterproofing agent and was long used in ship building. Early on they coated papyrus reeds to bind them together and also to make them impervious to water and, incidentally, rotting. The small round boat called the *gufa* is an example and the asphalt would be applied in the form of 'slime'. Later, when true ships were built using wood planking, the asphalt was mixed with fibrous material and packed into the joints between the planks, and called 'pitch'.

Asphalt after hardening is very tenacious, filling the cracks and difficult to remove.

The Bible says that Noah was instructed to caulk his ark with asphalt to make it seaworthy. Other literary sources also mention the use of pitch or asphalt in ship-building. If in plentiful supply, the asphalt was heated and applied all over the bottom of the ships to prevent attack by sea creatures. This coating was later replaced by lead sheathing.

Waterproofing

Asphalt is an excellent agent for waterproofing and was so used in ancient times. Baskets have been unearthed which show traces of asphalt and the reeds used for weaving. The interiors could be covered with slime, then dusted with clay, to make them leak-proof after drying. Fluids could then be carried in the basket. A Biblical example of this use was the basket in which Moses was set adrift on the Nile. In this case the asphalt kept the water out, as in boat building.

There were most likely local weavers who specialized in the making of baskets coated with asphalt, then traded them to passing caravans. These weavers could have possibly flourished if near a source of asphalt. Several fragments of these basket types have been found at Jericho although we do not know if it was a local trade industry.

Building

In the building trades asphalt was used in several different ways. It was used as mortar, as waterproofing, and as a preservative. The closer the source, the more extensive the use of asphalt, to the point of waste.

The walls of Babylon were cemented together with asphalt. A thin layer of slime [heated asphalt] would be applied in lieu of mortar, which would then hold the mud-bricks together as well as help protect them from water erosion. And according to Herodotus, every thirtieth course of brick was separated with a layer of slime mixed with straw or fibrous material for added strength. The ziggurat called the Tower of Babel was also cemented with asphalt to prevent erosion.

Floors were coated with asphalt and clay to make them more impervious to dampness seeping up from the ground. This idea was extended to roads also, although not extensively away from the capital. King Nebuchadnezzar built a bridge 370 feet long across the Euphrates River at Babylon and coated the wood support piers with asphalt [bitumen] to prevent their rotting.

Before waterproof plaster was invented by the Romans, asphalt was used to make cisterns waterproof, in this case holding the water in. Dams were constructed and the stonework caulked with asphalt to prevent leakage and dam failure. Walls of buildings near rivers or on floodplains were often caulked with asphalt, here to hold the water out. Sewers, when constructed, were often

constructed using asphalt between the brick or stonework. And use of the waterproofing material in the construction of bathtubs and other internal plumbing systems can be surmised, even if not attested directly.

Art

An artifact dating from c.3000 BCE has been found in Mesopotamia [Sumeria] which used asphalt as the adhesive for gold foil on statues. Other art objects used asphalt to glue shells on statues to simulate eyes. Stone chips were arranged and glued with an asphalt backing, as were occasional gem stones, into works of art. This idea of using asphalt as a glue was used in many applications, to hold some small detail in a larger art composition. Teeth and tongue in a statue of a lion, artificial eyes, mosaic clothes on idols, ivory panels on furniture, etc.

Other

The Bible mentions a furnace fired with asphalt for the condemned. While this would be an expensive use of asphalt, it's entirely possible. And a stick coated with a fibrous, tarry substance might make a good torch to explore caves, although rather smelly. The ability of asphalt to preserve organic materials led the Egyptians to include asphalt in their embalming process.

There are undoubtedly many uses of which we are unaware, as the main article did not survive the erosion of time. Ropes coated with asphalt to prevent their rotting; cloth wrapping coated to prevent dampness from getting inside; chests and containers made damp-proof to store foodstuffs or clothing. Perhaps they mixed a little sulphur with the asphalt on a torch and used this to keep bugs away during an outdoors event? The list seems endless.

HISTORY

The use of asphalt is so ancient that its beginnings are lost. The oldest attested use is possibly on a reservoir at Mohenjo-Daro in India, dating to the third millennium BCE. The material was called 'earth-butter' by these early Buddhist builders. And parts of the Bible also dating to this period, mentions pitch, or bitumen several times. The original Hebrew words are translated according to the perceived intent as to meaning. 'Pitch' for boat-building and 'slime' for water-proofing basketry.

Ancient Document Ref.

Different versions and translations of the Bible use different words for reference to asphalt. Words like slime, pitch, bitumen, asphaltum, naphtha; all attempt to convey an idea of the use of asphalt for a particular purpose. Here are a few of the references to asphalt, conveying an idea of its widespread uses:

[Gen 6:14.20]

Make yourself an ark of gopher wood; make rooms in the ark, and cover it inside and out with pitch.

[Gen 11:3.23]

And they said to one another, "Come, let us make bricks, and burn them thoroughly." And they had brick for stone, and bitumen for mortar.

[Gen 14:10.9]

Now the Valley of Siddim was full of bitumen pits; and as the kings of Sodom and Gomorrah fled, some fell into them, and the rest fled to the mountain.

[Exod 2:3.24]

And when she could hide him no longer she took for him a basket made of bulrushes, and daubed it with bitumen and pitch; and she put the child in it and placed it among the reeds at the river's brink.

[Isa 34:9.10]

And the streams of Edom shall be turned into pitch, and her soil into brimstone; her land shall become burning pitch.

[2Esdr 2:9.7]

...Sodom and Gomorrah, whose land lies in lumps of pitch and heaps of ashes.

[Sir 13:1.3]

Whoever touches pitch will be defiled, and whoever associates with a proud man will become like him.

[PrAzar 1:23.18]

Now the king's servants who threw them in did not cease feeding the furnace fires with naphtha, pitch, tow, and brush.

[Bel 1:27.4]

Then Daniel took pitch, fat, and hair, and boiled them together and made cakes, which he fed to the dragon.