THE STORY OF CHARCOAL

Construction of a Traditional earth covered Charcoal making Clamp

THE CHEMISTRY OF CHARCOAL

The chemistry of the charcoal begins with the wood, which scientifically named comprises substances called Cellulose and Lignin.

These substances have their origin in the air as Co2. The carbon element is then fixed by photosynthesis by combining it with the hydrogen in water to form Glucose and ultimately Cellulose. The oxygen from this process is released, as a waste product and eventually becomes the basis of aerobic respiration.

Throughout the woodlands and forests of the world, Carbon becomes locked up in the form of wood until the tree rots or is burnt. In burning the wood Co2 is then released back into the atmosphere.

If wood is heated to high temperatures in a controlled environment with little air (oxygen) it will produce charcoal.

To understand the chemistry of charcoal we have to observe the burning process in wood.

A burnt piece of wood will show a series of stages of break down depending on the degree of burning it has under gone. These stages are, firstly the unburnt wood which contains a high percentage of water: wood that has been heated will be dry, with less than 30% of water. The black Charcoal that is produced by this process is pure Carbon.

The Carbon (Charcoal) is revealed when the water and volatile gases in wood have been driven off and burnt in the form of a flame that glows and combines with oxygen in an exothermic reaction. This process is called combustion and in this burning process several elements are released. Light and Heat most noticeably also water and Co2.

Once burning is complete only the mineral part of the wood, the ash remains.

It is therefor essential in the production of charcoal to control the burning.

When wood is burnt or heated the temperatures rise to 100 —150 c at this stage water vapour as driven off. The smoke is thick wet and white, after this the temp begins to rise to 350— 450c At these temperatures the wood carbonises and volatile organic compounds are given off as a hot blue acrid smoke. If this temperature is allowed to rise too high the carbon will also burn and reduce to ash.

Carbon has a very strong affinity to oxygen and burns to produce light heat and Co2 With sufficient oxygen the temp will rise to in excess of 1000 degrees.

If the temperature and oxygen supply is controlled wood carbonises to give charcoal. The Charcoal retains the structure of the original wood down to the cellular level, it shrinks slightly and looses weight by about $1/6^{th}$.

The volatile organic vapours given of at the process of carbonisation are familiar to us and have been for millennia, because they ignite to form flames.

They contain the gases Co2 and Methane and have a calorific value of about one third of natural gas. If these gases are not burnt they can be cooled and condensed and they contain a whole range of interesting organic substances. Collectively the gases are known as Pyroligneous acid. This can be condensed to a aqueous mixture from which can be extracted, methanol, acetic acid, wood vinegar also Formic, Butyric and Propionic acid, Phenols and Tar. The heavier components of this extract could be rendered down to from wood tar and pitch.

A given quantity of charcoal produces approximately twice as much heat as the same weight of wood. Because burning charcoal produces temperatures in excess of 1000 degrees and is relatively easy to make; it has been used for centuries in the processes of metallurgy,(extraction of metals from their ores)

Charcoal with oxygenation by a bellows or blow pipe provides a controllable and clean fuel achieving temperatures hot enough to smelt different ores. Charcoals affinity with oxygen provided a reducing atmosphere, which released the metals from their oxide ore. Charcoal has been used to produce Zinc, Iron, Copper, Lead, Silver and Gold.

It has been and still is used for cooking and heating. It was used to provide heat to produce glass and it was used to make gunpowder.

Today its uses include chemical manufacturing processes that need pure carbon and as a filter and decolourising agent for gas, water smells and as a natural bleach.

THE HISTORY OF CHARCOAL.

We are looking at the oldest chemical industrial processes, dating back at least 5500 years.

Charcoal has been made ever since the first metallurgic processes were discovered and provided the heat needed for working and smelting Bronze, Copper, Iron, Silver, and to manufacture of glass.

Charcoal, being such a light substance, only 15% the weight of equal volume of wood was usually made in or near by the woods and then transported to where it was needed.

Charcoal was probably the end product of much of the wood cut down in Mediterranean Europe. In Ancient Greece, wood was so valuable that people took their windows and doorframes when fleeing wars.

Copper & iron production needed a lot of wood, it is estimated that, four acres of forest were need to produce a 60 lbs ingot of copper. Archaeologists have found vessels that contained 200 ingots off the coast of Cyprus. In addition it should be noted that people heated their houses and cooked on charcoal brassieres; all this use ultimately led to deforestation in these areas.

Charcoal was produced in the woods on levelled ground the charcoal clamps being protected from the wind in the woods. The trees were cut in the winter and the wood seasoned to be burnt in the summer.

A Charcoal stack was built around a chimney and covered with straw or bracken covered with earth and then lit at the top of the stack, allowed to burn and controlled by covering air holes with earth. The process took days and had to be watched day and night. When carbonisation was complete the charcoal was quenched with steam.

The best woods to produce Charcoal are hard woods like beech, oak, hornbeam and ash.

There was such a huge demand for charcoal for smelting iron, there were charcoal burners in the Forest of dean, Sussex downs and the New Forest. By the 13th century the numbers of charcoal burners was huge and the demand increased with the development of gunpowder as well as armour and other weapons of war. By the end of the 15-century a cannon could be caste in one piece.

All the while the demand on timber was also increasing; timber for ships and house building. By the end of the 17th century the general shortage of wood also led to a shortages of charcoal.

Sussex alone had 140 forges each using 5 tonnes of charcoal a weak. There was allot of money to be made in charcoal, and the by-products of charcoal were also important. By burning the charcoal over a pit, tar and pitch could be condensed out of the smoke, the tars being collected at the bottom of the pit.

The Egyptians had perfected the technique centuries before and used extracts from wood tars for the process of mummification.

Tar was vital for water proofing ships and preventing the attack of ship worms. When there was a shortage of coal tar production due to deforestation in England tar was imported from America produced from American Pitch Pined. Tar was also imported from Stockholm, Sweden, made from the stumps and knot wood of pine trees this was also used as an antiseptic, as it contains phenol.

By 1700 charcoal *was* so expensive, iron smelters began to look for alternatives. Abraham Darby experimented with putting coal, which was cheap, through a charcoal process to produce coke, this could then be used in blast furnaces.

The discovery of 'coke' (partially burnt coal) dramatically reduced the demand on charcoal, and the coke industry developed as a vital industry in its own right. The charcoal industry not being in such great demand for the iron smelting industry went on to specialise in many products extracted from the wood tars produced as by product in charcoal making.

Methods of charcoal burning improved, using large metal retorts a greater quantity of charcoal could be produced. Using a retort there was not the wastage in the burning process as with more traditional means.

The tars were more easily collected and were the source for many important products of the growing chemical industry.

In a parallel development the production of coke from coal also produced a by-product, 'coal gas' this was used for gas lighting.

The tarry by-product, coal tar, considered a waste product was unfortunately released into rivers causing a serious pollution problem. However when electricity began to replace gas lighting, the tarry by-product was exploited to produce aniline dyes, phenol and many plastics such as Bakelite.

Charcoal burning was eventually replaced by the coal tar industry, that was itself replaced with the discovery of natural gas and oil.

Environmental impact of charcoal making.

Around the world the history of charcoal has been associated with deforestation on a massive scale.

In Britain we are fortunate that even after a woodland or forest is clear felled it will grow back. The trees retain a huge living root system and are able to grow new shoots from the stumps.

The nutrient cycle is slow so there is little danger of much loss of topsoil. Woodland and Forrest soils are full of dormant seeds of forest and plants of woodland glades and they are stimulated to germinate by the increased light.

Woodsmen have known this for generations and the practise of managing a wood using felling is known as coppicing.

Many of our oldest woods have been cut and managed in this way and have regenerated.; for this reason these woodlands are known as ancient semi natural woods.

Coppiced woodland can be managed on a short cycle, of about 8years or on a long-term basis of a rotation of 100/150 years; which is the age for mature timber from large trees.

Continental forests were cleared on a much longer cycle.

Charcoal made from waste wood in these woods represents an example of a sustainable product.

In following and studying how man has managed his woodlands and forests we can see how we have impacted on our environmental ecosystems. We can see to what extent we have lived and worked in harmony with nature or to what extent we have only used natures resources to serve our own needs.

This relationship with nature is illustrated in many fairy tales; 'finding your way through the forest'.

This will be of significance and meaning to those who work sensitively and in a sustainable manner with the woods and forest. It would appear not to be the case with large companies such as The Forestry Commission who are only concerned with returns on investment.

Coppice not only provided a sustainable product but also has a great ecological advantages.

Today in the absence for the demand of locally produced charcoal, organisations such as RSPB and BTCV volunteers coppice woodland purely for the benefit of wild life; they don't even use the wood.

In the tropics the picture is a bit different the nutrient cycles are extremely fast and clear felling results in massive and permanent loss of soil.

Unfortunately 95% of British charcoal is imported from parts of the world with very delicate ecosystems, Singapore, Indonesia, and S. Africa. The charcoal from Indonesia is largely made from Mangrove, a dense wood coming from the tidal tropic zones an endangered habitat worldwide. The Mangrove prevents coastal erosion and provides the spawning grounds for native fish.

The Mangrove woods are cleared to make way for shrimp fisheries to provide the Japanese table market. Charcoal is also produced from wood that comes from rain forests and national parks, this is poached by people who do not have a foothold in the technological world.

Indigenous people cut the forest in small pockets that allow for regeneration. These woodlands are managed sustainably to maintain a constant supply of forest fruits and nuts, medicine and meat.

We still have to learn from mother earth and would urgently need to regain respect for her ecosystems. This would require that locally and globally we live a more sustainable life style.

Global deforestation is a huge problem we cannot exactly know the future but you can be sure we have to educate our children who will have to deal with the problems of global deforestation.