



Elements in the Leather Industry (Part 2)

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The elements of the periodic table have a diverse and interesting history. This article will attempt to bring some richness to the elements that are used or are present in the manufacture of leather or the treatment of its waste. This is not intended to be an exhaustive academic indulgence but more of an interesting interlude.

The Periodic Table is an arrangement of the pure elements in rows according to atomic number (number of protons) and columns so that elements with similar chemical properties fall in the same column e.g., alkali metals, alkaline earth metals, halogens and noble gases, as shown in *Panel 1*. These trends were recognised by Russian scientist Dmitri Mendeleev in 1869 and the structure of the modern periodic table is credited to him.

The elements are predominantly solids in their pure form

Panel 2: General chemical and physical properties of the elements

Metals: Usually solids, shiny, ductile, malleable, conduct electricity, conduct heat, like to lose electrons, and insoluble in solvents. Over 80 elements.

Non-metals: Usually gases, insulators of heat and electricity, low melting and boiling points, like to gain electrons, and soluble in nonpolar solvents. Only about 18 elements.

Semimetals: Also known as Metalloids, B, Si, Ge, As, Sb, Te and Po. Usually more than one form, semiconductors of electricity, and react similarly to nonmetals in many ways. May even appear metallic when pure.

Panel 1

The Periodic Table

1 IA New Original												18 VIIIA	
Alkali metals												Actinide series	
Alkaline earth metals												Poor metals	
Transition metals												Nonmetals	
Lanthanide series												Noble gases	
C Solid												Br Liquid	
H Gas												Tc Synthetic	
B		C		N		O		F		Ne			
boron		carbon		nitrogen		oxygen		fluorine		neon			
10.811		12.0107		14.00642		15.9994		18.9984732		20.1797			
Al		Si		P		S		Cl		Ar			
aluminum		silicon		phosphorus		sulfur		chlorine		argon			
26.981539		28.0855		30.973761		32.06		35.453		39.948			
K		Ca		Sc		Ti		V		Cr			
potassium		calcium		scandium		titanium		vanadium		chromium			
39.0983		40.078		44.955910		47.867		50.9415		51.9961			
Rb		Sr		Y		Zr		Nb		Mo			
rubidium		strontium		yttrium		zirconium		niobium		molybdenum			
85.468		87.62		88.90585		91.224		92.90638		95.94			
Cs		Ba		57 to 71		Hf		Ta		W			
cesium		barium				hafnium		tantalum		tungsten			
132.90545		137.327				178.49		180.9479		183.84			
Fr		Ra		89 to 103		104		105		106			
francium		radium				rutherfordium		dubnium		seaborgium			
(223)		(226)				(261)		(262)		(266)			
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with very few liquids (Br and Hg) and relatively few gases. The periodic table may be divided into a number of areas according to general chemical and physical properties, as shown in *Panel 2*, or the electronic structure of the elements as shown in *Panel 3*.

The elements described in this series are metallic and non-metallic elements, which make up many of the salts used in the industry.

Sodium (Na)

The name sodium was probably derived from the Arabic word for headache, *suda*, and a sodium compound called *sodanum* (Latin) was a known remedy for headaches in Medieval Europe. The symbol, Na, is an abbreviation for the Latin name, *Natrium*, first published by Jöns Jakob Berzelius in the early 19th Century. The name paid tribute to the mineral "natron" (from Egypt), which is a naturally occurring mixture of sodium carbonate, sodium bicarbonate, salt and sodium sulfate, extracted from saline lake beds in arid areas (Spanish *natrón*, Arabic *natrun*, Greek *nitron*, Ancient Egyptian *netjeri*, from the Wadi El Natrun, Egypt). Sodium was recognised as an element long before it was first isolated by Sir Humphry Davy in 1807.

Magnesium (Mg)

The names for the element magnesium and manganese are both derived from minerals found in the Magnesia district of Thessaly in Greece (also the word magnet). Magnesian stone was the original name for the mineral now known as "steatite" or more commonly as soapstone or talc. The name magnesium was coined by Sir Humphry Davy in 1808 (after his initial suggestion of magnium) when he isolated the element in pure form by the electrolysis of magnesium oxide. The healing power of Epsom salts (hydrated magnesium sulfate) was recognised in 1618 in Epsom, England, and milk of magnesia (magnesium hydroxide) was used to treat constipation, indigestion and heartburn.

Calcium (Ca)

Calcium is derived from the Latin *calx* or *calcis* for lime or limestone. If limestone (CaCO_3) is heated it produces quicklime (CaO) which can be hydrated or slaked to produce hydrated or slaked lime, Ca(OH)_2 , known chemically as calcium hydroxide. Sand and lime was used as a mortar in Italy as lime mortars withstood the moist climates of Italy better than the Egyptian mortars based on dehydrated gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). The name calcium was coined by Sir Humphry Davy in 1808 when he isolated the element in pure form by the electrolysis of calcium oxide. Chalk, marble and limestone are all forms of calcium carbonate.

Boron (B)

Boron is the only non-metal in Group 3 and has a similar chemistry to carbon and silicon. The name boron was proposed by Sir Humphry Davy in 1808 to describe the similarity between isolated samples of impure boron to carbon, i.e., *bor(ax + carb)on*. Borax was known from ancient times where it was used in glazes in China from 300AD and hard borosilicate glasses in ancient Rome. It took until 1824 for Jöns Jakob Berzelius to recognise that boron was a new element and until 1909 before high purity samples were produced. Boron is used in Pyrex glass and boric acid is a nerve poison.

Panel 3: the electronic structure of the elements

s-block elements: Groups 1&2. Electrons lost very easily (except for H and He), very reactive with H_2O and O_2 and are fire hazards (except Be and Mg).

p-block elements: Groups 13-18. Mostly nonmetals and semimetals with a few metals, viz., Al, Ga, In, Sn, Tl, Pb and Bi.

d-block elements: Also known as the Transition Metals. Groups 3-13. Properties become slightly less metallic as we shift from left to right.

f-block elements: Also known as the Lanthanide and Actinide Series. Highly reactive metals, very dense with high melting points and many have radioactive isotopes.

Chlorine (Cl)

Common salt (NaCl) has been used for millenia with archaeological evidence for the use of rock salt in 3000BC to written records about salt in ~400BC. Salt was used in ~200BC as part payment for services (hence the term *salary*) and in the purification of noble metals in ~100AD. The use of *aqua regia* (HCl/HNO_3) to dissolve gold is well known from the thirteenth century onwards. Concentrated hydrochloric acid was first produced in 1648 by Johann Rudolf Glauber and hydrogen chloride gas by Joseph Priestley in 1772. Chlorine was the first of the halogens to be isolated by Carl Wilhelm Scheele in 1774 who mistakenly thought it contained oxygen. Sir Humphry Davy recognised that chlorine gas was an element composed of diatomic molecules, Cl_2 , rather than single atoms and the name proposed by Davy in 1811 describes the colour of the gas (Greek *chloros* means yellowish or light green).

Sulfur (S)

The destruction of Sodom and Gomorrah by "Fire and Brimstone" in the Bible are some of the earliest references to sulfur (brimstone). Sulfur was known to the Egyptians (~1600BC) and both Homer and Pliny the Elder mention its use as a fumigant among other things. Gunpowder (mixture of saltpeter, carbon and sulfur) was discovered by Friar Roger Bacon in ~1245, although the Chinese and Arabs had produced incendiary powders centuries earlier. Antoine Lavoisier suggested sulfur as an element in 1777 but this was contradicted by Sir Humphry Davy. It was finally established as an element by Joseph Louis Gay Lussac and Louis Jacques Thénard in 1809. The spelling sulfur (with an *f*, not *ph*) was adopted by IUPAC (International Union of Pure and Applied Chemistry) in 1990 and by the Royal Society of Chemists in 1992. Latin *sulpur*, *sulphur* and *sulfur* and Sanskrit *sulvari*, all refer to brimstone. The Greek word for sulfur is *thion* hence the prefix *thio-* for many sulfur compounds. 🌐

Acknowledgements

- Greenwood N.N. and Earnshaw A., *Chemistry of the Elements*, Pergamon Press, Oxford, United Kingdom, 1984
- Panel 1: Periodic Table: <http://www.dayah.com/periodic/Images/periodic%20table.png>