Fritz Haber (1868-1934)

Topics

Industrial chemistry, thermodynamics, chemists

The German chemist Fritz Haber is best-known for developing, along with Carl Bosch, the Haber (or Haber-Bosch) process for making ammonia from nitrogen (from the air) and hydrogen (from water and / or natural gas). The ammonia produced is converted into nitric acid and other nitrogen compounds and is the ultimate source of most of the nitrogen found in synthetic chemicals including fertilisers, Nylon and explosives. Virtually all explosives contain nitrogen – examples include TNT and nitroglycerine.

The Haber process was developed in the first decade of the twentieth century and came at a critical time for Germany because the First World War was about to break out. Prior to the Haber process, nitric acid for making explosives was made from nitrate salts imported from Chile in South America. Some of these are found in geological deposits but another source is guano – seabird droppings found on the coast and on islands. At this time, the British Royal Navy 'ruled the waves' and could easily blockade the import of nitrates to Germany. Without nitrates, Germany would have been unable to make explosives and the War would almost certainly have been much shorter. The Haber process changed all that – the raw materials for the Haber process are available everywhere.

Haber had another effect on the First World War. He was a patriotic German and used his chemical skills to help the war effort by organising the use of poison gas. Chlorine was first used by the Germans at the battle of Ypres in France in 1915 where it was released from cylinders and carried by the wind towards the Allied (French and British) trenches. The Allies later retaliated and, in fact, gas was more effective for them than for the Germans because the prevailing wind in Northern France tends to blow from west to east, *ie* towards the German lines.

The western allies were not prepared for the use of poison gas by the Germans and had no gas masks or other precautions in place. Troops were initially advised to breathe through urine-soaked handkerchiefs (which would, presumably have the effect of dissolving some of the chlorine). Some veterans recall never fully emptying their bladders when in the front line – 'just in case'. Later, cloth soaked in sodium thiosulfate solution was used – this reacts with chlorine:

$Na_2S_2O_3(aq) + 4Cl_2(g) + 5H_2O(l) \rightarrow Na_2SO_4(aq) + H_2SO_4(aq) + 8HCl(aq)$

Another suggestion was to use the charcoal from burnt coconut shells as an adsorbant, although it is not clear how many of these nuts were likely to be found at the front! Later, purpose-built gas masks used activated charcoal as a filter.

After the war, the victorious Allies required the German state to pay 'reparations', in effect damage payments. These were extremely heavy and in fact were almost certainly a factor in the rise to power of Hitler. Haber worked on a scheme to extract gold from compounds found in seawater to help pay the reparations but it was not a success. There is in fact a great deal of gold in the whole of the World's oceans (one calculation gives a mass of 8000 million tonnes) but it is so dilute that it is not practical or economic to extract it.

Ironically for one who had worked so hard for Germany, Haber had to flee his country in 1933, as the Nazis came to power, because of his Jewish ancestry.

Haber was awarded the 1918 Nobel Prize for Chemistry for his work on the process that bears his name. Since Nobel Prizes are awarded by The Royal Swedish Academy of Sciences and Sweden was neutral in the First World War, the fact that Haber was a German was not a problem. Haber is also known for the Born-Haber cycle – a thermochemical cycle which allows us to calculate the lattice energies of ionic compounds.

Haber's first wife, Clara, was also a chemist (she was the first woman to gain a PhD in chemistry from the University of Breslau). At the time, it was not considered proper for married women to carry out scientific research but she assisted her husband in his work, although without credit. In 1915 she committed suicide, apparently distressed by Fritz's enthusiasm for poison gases.