Part III

Math of Proof

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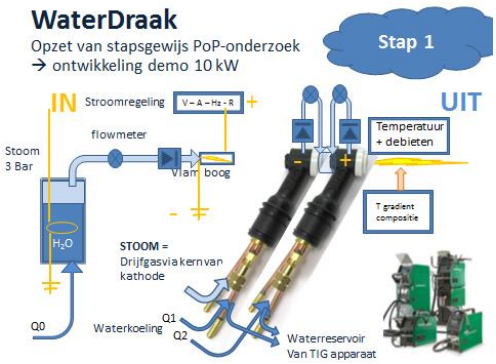


My foundation's president Jan Geu is terribly excited about the tax increase on natural gas. For medium-sized customers more than for small and large customers. His process industry uses a lot of natural gas to make steam. The question is whether water gas can provide an alternative? Can Watergas.NU find a way out? Watergas can be mixed with natural gas. That saves on fuel anyway. However, it is the question whether the increased capital costs amount to less than the amount of natural-gas saving. As soon becomes clear that it is hard to compete with natural gas. In fact, natural gas is still cheap. It costs only about 2.2 cents per kWh of calorific energy. However, it is possible with "normal" watergas to compete with natural gas.

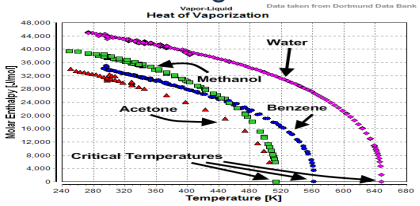
Lots of steam to produce? I think that a water plasmatron is better suited to this end than watergas electrolysis. Advantage: the plasmatron is proven technology.

The plasmatron is much like a plasma torch. With a plasma welder you create an arc between the metal workpiece and the high voltage torch. First a small electron arc is made in the torch itself. By a propellant, the arc is blown outside. The arc then jumps over to the workpiece. The current increases and the arc melts the metal. The propellant is normally an inert gas, such as argon. With the plasmatron of Puharich supercritical steam is used as a propellant. A microwave heats cold water to steam. To my opinion, the device of Puharich is a bit too complicated. The welder does indeed virtually the same. So my model combines two welding torches. Between the two welding heads a small plasma-flame process chamber is created.

The rear welding head is the negative and the front one is the positive pole. Thus, the electrons are moving from back to front, along with the flow. One electrode is used, which runs forward from the rear welding head. The opening of the front welding head is made a bit smaller to form a good flame torch. I choose this double plasma-welding head set-up because they can be cooled. In the spreadsheet model I built, cooling water is injected (in part) into the electric-arc process chamber, as applied in various studies of water-plasma, such as Hrabovský et al ..For the purpose of this calculation, this feature is 'switched off'.

1 liter of water =
55,6 Mol H_2O
Binding energy
917,8 kJ/Mol
1 kJ = 0,000278 kWh
14,6 kWh/liter of water

Heating
Water: 4,9 kJ/kg/^oK



Energy to break vapor tension
At 100 ^oC: 2250 kJ/kg
At 300 ^oC: 1390 kJ/kg (56%)
Steam
to 3000 ^oC: 1,41 kJ/kg/^oK

Input of electricity:

1,32 kWh electricty and

15% power loss to device

After plasma formation voltage falls about 90%

Water consumption 90 ml

-0,03 $kWh_{water\ (1)}$

-0,03 $kWh_{evap\ (1)}$

-0,10 $kWh_{steam\ (2)}$

Binding energy of water

1,25 kWh watergas (1)

The mathematical equation:

Electricity	**+ 0,11 kWh**
Heating	**-- 0,16 kWh**
Binding energy	**+ 1,25 kWh**
Total	**+ 1,20 kWh**

Currently I do not have a mini-plasmatron at my disposal anymore to estimate the parameters. A call to House Heating Systems offers a solution. This company develops a central heating with the plasmatron. They use about the same Puharich device. Their measurement of the water consumption is roughly equivalent to my own perception. For other parameters, Wikipedia is the source.

The heat, which is produced by the electric current through the welding head, evaporates the water. The vapor has only a small space available. Thus, the pressure is very high, because the water expands by a factor of almost two thousand. At a higher pressure less energy is needed to break the vapor pressure (on the left you will see the graph). Vaporizing half a glass of water every hour consumes as much energy as the lamp over the dining table. The vapor enters the arc chamber. Above 675 ° C steam gradually begins to fall apart 'automatically' into hydrogen and oxygen. The steam is further heated by the intense heat of the arc. At 3000 ° C the steam is completely converted into hydrogen and oxygen, and further to a charged plasma. The electrical resistance is greatly reduced. The voltage drops under my own observation to one tenth of the initial voltage. Plasma consists of electrons and atomic nuclei, so in recombination, the entire binding energy of water becomes available. The math of the energy balance shows that electricity alone suffices to transform the water to plasma. When cooling water is injected – and cooling is really necessary! - then the energy yield is obviously higher because more water = fuel is added. Thus the plasmatron becomes a multiplier!

Water therefore is a source of energy with this technology!.

Jan Geu; yes we compete with natural gas; 1.8 cents / kWh.

Jules, you're right; Electricity is now a commodity and more manageable than more than two centuries ago. Water is the fuel of the future. Well seen!

To the National Research Agenda: adopt research on water-energy. My heart's desire: a chair with young researchers at university level (RUMC?) to develop the "Water Dragon". The upper image shows step one of a development plan for equipment to produce steam and hot water. Let's get started!