BREAKING THROUGH EDITORIAL

When Water Flows Over Smooth Metal

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In hydroelectric turbines, the water rushes over smooth turbine blades. The hope of upgrading[1] such turbines, over and above their currently estimated energy transfer efficiency of 95%, depends on extracting additional energy from the intermolecular hydrogen bonds and somehow adding this energy to the gravitational energy stored in the water behind the dam. This seems a tall order, but it is not impossible. An early indication of bond energy liberation was the electrocution/shock of a steam pipe handler. The accident occurred around 1840 in the north of England, apparently at Cramlington Colliery. The unfortunate man, who held the nozzle in one hand and rested the other hand on a water pipe, formed a link between the charged nozzle and the ground.

A loud arc discharge at the steam nozzle seemed to have sent an electric current pulse through the body of the workman. The incident was discussed in *Philosophical Magazine*, and Lord William Armstrong and Michael Faraday proposed explanations of the electrocution process. It was determined that the arcing from the nozzle could be repeated with wet steam (vapor and droplets) but not with dry steam (vapor only). Faraday thought the electrical discharge was caused by impurities in the water. But there was no report of clean water preventing the arcing.

It seems most likely that it is the triboelectric effect that gives rise to the arc voltage. This refers to the electrostatic charging of a conductor by friction, for instance by rubbing metal with a cloth. The rubbing seems to remove conduction electrons from a conducting surface and leaves it charged positively. The water droplets in wet steam are dielectrics and, therefore, should cause the same effect as a cloth. The driving force in a nozzle (pressure) and friction both act in the direction of relative motion. Therefore, as well as generating heat and separating charge, the friction is responsible for efficiently rupturing hydrogen bonds in the droplets and the consequent release of stored energy. This can lead to enhanced velocity, further friction and increased charge separation, which can clearly create lethal voltage that does not occur with dry steam which contains no hydrogen bonds.

Not much more can be said with certainty about the electrocution incident. It would be helpful if somebody could rather more carefully verify this effect by repeating blowing wet and dry steam through a metal nozzle and measuring any generated voltage.

Much can be learned from a simple experiment in the kitchen sink. When a vertical stream of water strikes a horizontal flat metal plate, laid on the bottom of the sink, it will be seen that the water is not reflected vertically upward, but it is deflected radially outward on the smooth metal plate. This is a demonstration of the inelastic behavior of liquid water. The horizontally flowing water forms a thin continuous layer which expands radially and has a circular boundary. As the circle gets larger, the water layer seems to become thinner.

Then suddenly, an inch or more away from the impact area, the layer thickness increases in a step at R1. Within a short distance, the layer thickness drops back to its original value at R2. The explanation of this phenomenon is likely to reveal more about the sliding of water over a smooth metal surface.

The most important question is: does the kinetic energy of the water increase at the impact of the jet on the metal plate? Just looking at the experiment, the first impression gained is: yes the water speeds up at the 90° deflection of the water stream. It is certainly worthwhile to check this crude observation with measurements. If true, we would have found a very simple method of capturing hydrogen bond energy to boost the energy input to a spider turbine.[2]

The upgrading of existing hydroelectric plants depends on inventions of this kind which will feed liberated intermolecular bond energy into hydroelectric electricity generators. The raised ring of water on the metal plate at R1 is a curious phenomenon. The only explanation found so far is that the water flowing radially outward over the metal plate accelerates gently until some parameter drops below a critical threshold and the acceleration force suddenly ceases. This would instantly increase the layer thickness. No convincing explanation has yet been found of the sudden decrease in water layer thickness at R2.

The kitchen sink experiment is a "must" for continuing research on the liberation of hydrogen bond energy. It takes very little effort. The first question is what is the ratio v_h/v_v, where v_h is the horizontal flow velocity away from the impact area and v_v is the vertical velocity before impact? If the ratio is greater than one, then water impact produces hydrogen bond energy, *provided* all measurement errors are negligible. To determine v_h, we have to measure the depth of the water layer d, at some chosen radius r′. The kinetic energy efficiency is ($\mu = (v_h/v_v)^2$). Since no water accumulates

along its flow path, the efficiency has to be equal to the inverse flow area ratio $(A_v/A_h)^2$, where A_v is the cross section of the downward flow and A_h is the area of the cylinder of radius r' and height d. We hope this latter ratio can be made greater than one. If the possible error in the area ratio turns out to be too large, then a more precise "kitchen sink" experiment has to be designed, built and tried.

It is well known that liquid water adheres to metal surfaces. The attraction between the two substances is believed to be of electrical origin. When water is flowing over metal, the attraction sets up a drag force on the water surface molecules which increases with relative velocity. At some point in accelerating water, the drag force (water tension) will become large enough to break the hydrogen bond between two neighboring water molecules and liberate the stored bond energy. If we talk about the rupture of the chemical bond between two neighboring H_2O molecules, we mean a so-called hydrogen bond between an oxygen atom in one molecule and a hydrogen atom in the neighboring molecule. The tensile hydrogen bond rupture distorts the electron structures of the molecules sufficiently to reduce the screening between the positive nuclei which will then repel each other in the flow direction. This is the proposed mechanism by which hydrogen bond energy (HBE) transfers into the turbo generator.

An unpublished experiment, similar to the kitchen sink experiment, has been performed with a fast fog jet. The fog jets produced in a series of capacitor discharges, travelled at vertical speeds up to 500 m/s. Fog is a collection of very small liquid water droplets of 1 - 100 µm diameter. When striking a strong horizontal aluminum plate, the fog jet spreads out in a thin radial layer. Measurements with high-speed cameras indicated that the horizontal fog velocity in the thin radial layer was definitely greater than the vertical velocity. Hence we have two different experiments, one with water and one with fog, which indicate that the impact of water on a smooth metal surface increases the kinetic energy of water droplets.

Another device in which water slides over a smooth metal surface is the convergent nozzle. Under the right circumstances it can double the water velocity and therefore quadruple the kinetic water energy. There have been claims that, with the right configuration, the kinetic energy of the flowing medium can be increased at the expense of pressure *and* internal water energy. Hydrogen bond energy is a principal constituent of internal water energy. Many papers in the water literature do not mention internal water energy. The simplicity of the installation of a garden hose nozzle in the water stream makes this a compelling demonstration of HBE liberation.

Pipe friction is another factor which enters the research on HBE liberation. While friction certainly is an energy conversion to heat, it has not yet been investigated whether bond energy can reduce the apparent friction loss in a pipe, or make it completely disappear. Furthermore, it has been found that a right-angle bend in the pipe increases the kinetic energy of a fog jet produced by a water arc explosion. This is yet another indication of the water kinetic energy increasing on impact and sliding along a metal surface.

The foregoing discussion quite strongly suggests that water and fog flowing over a smooth metal surface liberate hydrogen bond energy. For the case of water impact on turbine blades, therefore, the prospect of converting this extra energy into electrical energy is good. Until now experimental results have shown that the mechanical behavior of coherent liquid water and fog is indistinguishable. So if fog accelerates when sliding over smooth metal, so should liquid water experience an acceleration force.

From the simple model of water sliding over smooth metal, several small experiments have indicated that HBE exists in ordinary cold water. If the water, having given up some of its HBE, is exhausted to the environment, it will eventually evaporate and return to higher ground with its bond energy restored. Therefore HBE is clean renewable energy for as long as the sun continues to shine on the earth.

References

1. Graneau, P. 2008. "Upgraded Hydroelectric Water Turbines," *Infinite Energy*, 13, 78, 29.

2. Graneau, P. 2007. "The Challenge of a Fog Pulse Turbine," *Infinite Energy*, 13, 73, 11.

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