The piezo-electric effect

Presented by
Tor-Henning Iversen
dr.philos., professor em.
https://bio-consult.net

Bergen, September 18th, 2022

In principle of the DabV-units are based on *piezo-electricity* (from greek; piezein; «to press» and «to squeeze») which is a natural phenomenon where electrical charges are produced when a material composed of crystals is exposed to pressure. The piezo-electric effect was described by the French couple Jacques and Pierre Curie as early as in 1880. When crystals are exposed to a pressure this will cause an electrical polarization and electrical charges are accumulated in one end of the crystal (see Figure 1). The electrical voltage created will vary proportionally with the pressure intensity. The same will occur if the crystal is exposed to stretch, but with the production of an opposite voltage. In this way one can use piezo-crystals to generate alternating current – by alternately to compress and stretch the crystal.

The basic principle for instruments based on piezo electricity is a minimum of components. They are very effective and convert up to 90% energy which means that it is possible to construct very compact apparatus such as the DabV-units. The area of use for piezo-electricity is within the fields of ultrasound, sonar, sensor-technology, engine ignition systems, types of inkjet printers and alarms (e.g.in smoke alarms). The same method is used to transfer current/energy wireless as induction current. This is a method applied in the offshore industry when high voltage current is linked to a contact 100% isolated. It can be obtained when the high voltage current is transformed to electromagnetic current and further being transformed back to high voltage current.

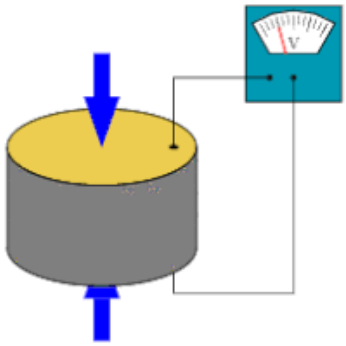

Figure 1. *A piezo-crystal gives currency under pressure*[1]

[1] https://no.wikipedia.org/wiki/Piezoelektrisitet

The DabV-unit contains an energy source transfered wireless, which is a confidential development based on the piezo electrical mechanism (Wu et al. 2018[2], Chen et al. 2019[3], Nie et al. 2020[4]). Piezo electricity is the electrical charging which is accumulated in different types of solid materials as a response to mechanical pressure which will cause an electron excitation. Mechanical energy will as such be transferred to chemical energy which then will be bioavailable. The DabV-unit restructure the water by disturbing the polar bindings which makes the water molecule more bio-available. The DabV-units will be activated when linked to water and the maximum effect is obtained related to water in movement. The details of construction and function of the DabV-unit will not be further elaborated here.

The drinking water and the health aspects is dealt with by the waterworks in Norway today to distributed in a hygienically safe way. The major goals are to inactivate microorganisms (disinfection), removal of particles and organic material (humus), remove other inorganic unwanted components and adapt the water quality to the wiring (corrosion-control)[5].

In Norway the drinking water shall pass minimum two hygienic barriers. The drinking water regulation §3, point 2 defines a hygienic barrier as a «Natural or artificial physical or chemical obstruction, including measures to remove, neutralize or kill bacteria, viruses, parasites etc., and/or dilute, break down or remove chemical or physical substances to a level where the substances in question no longer represent a health risk»

The barriers for water are subdivided in physical removal and disinfection. The majority of the waterworks in Norway include an UV system. This plant is type approved by The Norwegian Institute of Public Health[6]. The dose of the UV radiation is dependent on the extent of the microbial contamination and the increase of color number (fargetallet) of the water. The UV system is extremely expensive. For comparison a DabV-unit placed on the water intake (e.g. from a well which contains water from the roof) will cost only a fraction of a complicated UV system. UV disinfection is light and does therefor not travel well through organic matter. DabV, on the other hands, uses sound, which travels well through organic matter.

[2] Wu et al. 2018. Piezoelectricity Induced Water Splitting and Formation of Hydroxyl Radical from Active Edge Sites of MoS 2 Nanoflowers. Nano Energy 46.

[3] Chen et al. 2019. Piezo-promoted the generation of reactive oxygen species and the photodegradation of organic pollutants. Applied Catatalysis B. Environmental. 258, 118024

[4] Nie et al. 2020. High piezo–catalytic activity of ZnO/Al2O3 nanosheets utilizing ultrasonic energy for wastewater treatment. Journal of Cleaner Production, 242, 118532

[5] https://www.norskvann.no/index.php/vann/vannbehandling

[6] «Planlegging og drift av UV-anlegg», E. Andersen, T. Krogh & V. Lund, VANN4-2006 (s. 334)