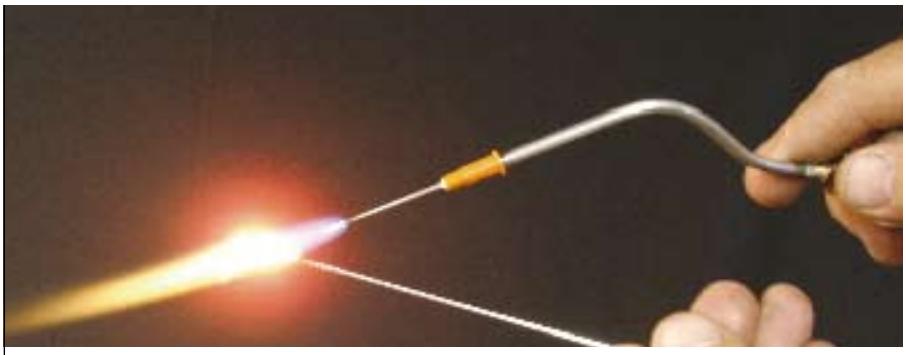
NEW WELDING TECHNOLOGY IS FLAMING HOT



The concept of welding using hydrogen and oxygen obtained through hydrolysis is not new. Previous equipment was bulky, inefficient and unsafe, but new technology such as a high-power metal-oxide semiconductor field-effect transistor (MOSFET) direct current (DC) welding inverter is a viable option. These inverters are used as a power supply for a gas generator to perform hydrolysis and obtain hydrogen and oxygen as fuel gas.

The gas generator is used as an accessory to the DC inverter for gas welding and for performing a variety of electric welding operations. This system was developed mainly for the jewellery and dental industries. Performance here has been excellent as the flame can be concentrated on a small area without unnecessarily overheating materials. Hypodermic needles, available in a wide and inexpensive range, are used as welding torch nozzles. The hydrogen component in the flame is not feasible for the welding of steel, as the welding becomes brittle.

The Hydro-tech Combo welder
Multiple engineering disciplines were involved in the research, development and construction of the Hydro-tech Combo welder. Electrical engineering was involved in the concept design and implementation of the DC inverter. Electronic engineering was responsible for designing the electronic control system and ensuring the safe operation of the gas production. Chemical engineering was responsible for ensuring the right composition and concentration of the chemicals for the electrolysis in the reactor. Mechanical engineering was responsible for the design, manufacture, construction and documentation of the mechanical components in the system. Mining engineering set the parameters for the safety regulations in the testing and use of flammable gases in the industry. Metallurgical engineering played a crucial role in the choice of materials in the system and determining the lifespan and service intervals of critical components. Industrial and systems engineering was involved in the planning, costing and production of the units for the general market.

Advantages
The Hydro-tech Combo welder is cheap to operate and functions by using pure and electric current. One litre of water produces around 80 000 litres of $2H0_2$. Electric consumption depends on the flame size and there is no need to buy fuel gas again. The welder can be stored indoors, as no flammable gas is under pressure. Gas production stops when electrical current is terminated. The by-product of the flame is pure water and it is therefore environmentally friendly. The unit is compact and portable. Other advantages include the fact that the unit can be supplied as an accessory to an existing DC inverter (welder) for gas welding, or as a unit with a DC inverter welder. Gas is generated on demand and it is electronically controlled. No bulky high-pressure cylinders, gas regulators or valves are required.

Gas generation
A perfect mixture of hydrogen and oxygen is obtained when water is broken down into its basic elements through electrolysis. When this mixture is ignited, a colourless flame with a temperature of 3 300°C is produced. The gas generator in the welding unit is specially designed and modern inverter technology is utilised to produce this function. The power source uses high-power MOSFETs to connect 220V AC to 50Hz up to 100kHz. Low-voltage, high-current output then reduces the voltage and increases the output current via pulse width modulation. The gas mixture from the generator is bubbled through methanol, which colours the flame when used.

→ *Jan Brand, an instructor in the Department of Mechanical and Aeronautical Engineering at the University of Pretoria, developed a new micro-welding device using the hydrolysis of water. For his innovation, he won the Popular Mechanics Inventor of the Year Award. (Further information: jan.brand@up.ac.za)*

Electrical (arc) welding
The power supply of the gas generator has a dual purpose. As a DC inverter, it can be used as an excellent arc-welding machine. With the necessary accessories, metal inert gas (MIG) and tungsten inert gas (TIG) normal arc welding can be done on a wide variety of weldable materials. The unit has a duty cycle of 60% and an output current of 30 - 200A.

Safety features
The system incorporates various safety features such as flashback arresters and pressure switches to prevent accidental explosions and gas build-up. The volume of flammable gas is not large enough at any stage to cause serious damage in case of an accident. An electrical solenoid valve prevents electrolyte spillage and leakage when the unit is switched off or not upright. It has a fail-safe electrical control mechanism and gas is generated on demand and is electronically controlled.

Research and development
This welding unit has been researched and developed over three years by University of Pretoria instructor, Jan Brand. Various systems and theories were tried and tested, beginning with the most basic components and materials. Promising results were obtained and, as the developments progressed, a few working prototypes were built and are being used. New technology was incorporated into the system as it became available, making it viable and marketable to industries. The addition of a plasma cutter into the unit is currently being researched.