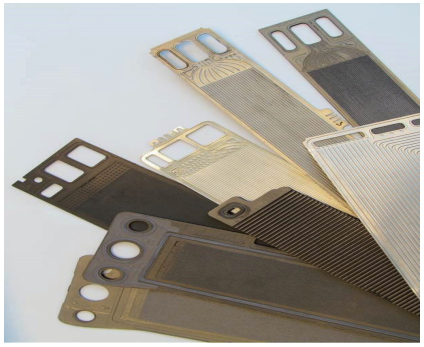
TECHNICAL NOTE

RECYCLING PEM FUEL CELLS

END-OF-LIFE MANAGEMENT

FUEL CELL RECYCLING & PLATINUM RECOVERY

Proton exchange membrane (PEM) fuel cell technology generates clean electricity from hydrogen to power a range of applications, both stationary and motive — while emitting nothing but water. Fuel cells are an environmentally friendly alternative to polluting internal combustion engines and batteries containing toxic materials, such as lead acid. PEMfuel cells contain no poisonous or hazardous materials that may impact the environment upon disposal.



With many years of fuel cell manufacturing experience, Ballard Power Systems, Inc. has developed industry leading processes designed to minimize the energy intensity and environmental impact of product production. At the end of a product's useful life, processes ensure the efficient recovery of highly valuable precious metals and minimize waste entering the landfill.

MANUFACTURING PROCESS

Ballard's production facilities are continuously monitored and optimized in all aspects of energy consumption and environmental emissions.

Our products are designed to meet very strict environmental requirements, restricting the use of certain hazardous substances in electrical and electronic equipment.

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IN ADDITION:

- All products are designed to meet the WEEE directive for product end-of-life management and recycling methods.
- All materials are chosen with consideration to a list of banned and restricted substances.
- Packaging materials used during transportation and storage can be recycled or reused.
- All products are designed so that no special equipmenti s needed to dismantle and separate the components of mechanics, cables and printed board assemblies.
- A special recycling process has been designed for recovering platinum from the membrane electrode assembly (MEA).
- All substances in the Ballard facilities are registered and evaluated. No hazardous materials are allowed.

FUEL CELL STACK REFURBISHMENT

Ballard offers its customers a refurbishment program for fuel cell stacks that have reached the end of life. The customer returns the fuel cell stackto Ballard where we replace the MEA while reusing the existing hardware and plates. The used MEA is then sent to a 3rd-party for recovery of the platinum and other precious metals.

This process can generally be done for fuel cell stacks that are ten years old or less and will typically save customers 30% of the cost of purchasing a new fuel cell stack.

Refurbishments reuse plates and hardware

>95% of the precious metals in the MEA are reclaimed during recycling

FUEL CELL STACK RECYCLING

Once a fuel cell stack has reached the end of life, Ballard can facilitate the ecycling of the MEA. Typically, more than 95% of the precious metals in the MEA are reclaimed during this process. The majority of the remainder of components in a fuel cell stack are recycled using ordinary recycling processes.

FUEL CELL SYSTEM RECYCLING

When taking a broader look at a fuel cell module and not only a fuel cell stack, a number of other more standardized components are involved. These include electronics, pumps, valves, hoses and metal for housing and frames as the main components. These components are all commonly used components which are easily recycled and meet standard regulations, such as WEEE for general recycling.

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