

# The heat is RISING

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an advanced technology to directly heat  
any fluids via electromagnetic induction



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**Above right: One of the units (a 52KW variant) ordered by Petrobras**

**Above left: A 20KW version of the DIFHEMI solution**

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**S**team or thermal oil is used all around the world, and for a long time now, has been heated by means of non-renewable energy sources, such as fossil fuels or electrical resistances. In industrial processes heating is usually done indirectly, by heat exchangers, heat fluids (liquids and gases). These systems, although valid, have many deficiencies. Burners are pollutants that go against the Kyoto Protocol and generate high thermal losses over the heating processes and, consequently, a low exergetic value. For instance, in the first stage of use of a boiler to heat up any fluid, energy is lost during the burning fuel process.

In the second stage, more energy is lost in order to transfer the heat generated by the flame to the wall of the vessel containing water. Then more energy is lost in the third stage, when

the container transfers its energy to vaporise the water. In the fourth stage, even more energy is lost to heat the pipes and the heat exchanger; when steam heats, indirectly, any kind of fluid resulting in another energy loss. If we perform an exergoeconomic analysis, adding these losses together (in other words, an exergetic control of the various components), a low utilisation of the thermal potential is found, and consequently, a high operating cost.

The origin of a more modern technology in this field, called DIFHEMI (an acronym for Direct Fluid by Electromagnetic Induction Heating), goes back to the principles of an electrical power transformer with the use of exergy generated by magnetic induction. Its heating system transcends others due to its simplicity and security, rendering its predecessors thermodynamically obsolete. By

## Among the range of applications for the DIFHEMI system are the following: bath heating for surface treatment; distillation and concentration of chemicals; pharmaceutical processes; and operations in hazardous areas in the chemical and oil industries

comparison, if we want to heat any fluid with the DIFHEMI, it will not be necessary to go through all those stages described above; we simply use exergy generated by electromagnetic induction and the fluid will be warmed up in only one stage.

With DIFHEMI, fluid enters the inlet tube, goes through the long internal tube bundles and goes out the outlet tube, immediately heated to the target temperature, pressure and flow, with great use of energy and operational simplicity. The system does not generate pollution of any kind, has no noise, is static, does not require any peripheral equipment, is naturally cooled, needs no complicated government and environmental agency permissions and controls, does not provide risks

of explosion and does not require maintenance. It is greatly superior from a thermodynamic standpoint at 10-30% better than traditional heaters. The equipment works automatically, is compact, easy to install and requires little investment and low operating costs.

Instead of going through all four stages losing a lot of energy, why not go through just one stage gaining energy? For a better and wider use of available exergy, its makers have introduced this heating system to the market, eliminating the losses of conventional systems of indirect heat exchange and their respective transportation, since the DIFHEMI system can be located close to the points of consumption due to its reduced installation space.

## HISTORY OF DIFHEMI

In 1983 the world economy was looking for alternatives to avoid global warming, with the implementation of the new guidelines initiated by the Kyoto Protocol in 1997, and at the same time it was facing an increasingly competitive market. Anticipating the future, some pioneers in this sector decided to innovate by starting the production of Direct Fluid by Electromagnetic Induction Heating (DIFHEMI). After countless calculations and practical experiences, these pioneers, who were working in the Thermal Engineering department at Brascoelma, successfully developed and created their own equation for accurate calculation of DIFHEMI in any fluid inductive heating situation. Aligned with an experimental prototype, they introduced to the market this current, innovative heating industry technology, whose equipment allows achieving unprecedented exergetics income, typically greater than 98% and the heating directly any kind of fluid, liquid or gas.

The 'exergy' concept according to Rant and Kotas is where energy is a property of a system according to the first law of thermodynamics and cannot be destroyed (conservation of energy); in each transformation one part is lost, that is, the part that is not used to do work. Rant proposed the word 'anergy' to refer to the portion of energy that is not



used. So, we can say that energy is the sum of the portion of all energy that is used (exergy) and the portion that cannot be used (Anergy) as shown in the equation:  $\text{Energy} = \text{Exergy} + \text{Anergy}$ . According to Rant, exergy is the portion of the energy that can be converted into any other energy source, that is, the portion that can be transformed into heat or work. According to Kotas, this measure means the maximum work performed by the system in its interaction with the environment to reach the balance. ■



**A DIFHEMI system in situ**

The concept can be summarised thusly: in applying voltage in the primary coil, getting heat from the secondary coil tube bundle, which through Joule effect (since the coil has its terminals short-circuited) means that all energy applied to the primary will be transformed into thermal energy in the secondary, where the fluid circulates, providing an high exergetic thermoelectric efficiency of at least 98%.

## APPLICATION AREAS

The DIFHEMI is an ideal solution for the direct heating of any type of fluid among dozens of applications in the field of thermal engineering. Common applications include thermal fluid heating for molding tools, thermal traces, chemical reactors, oils or chemical storage tanks, tunnels and presses for vulcanisation of rubber. It is also well suited for the direct heating of corrosive solutions (acid and basic) and easily cracking oils and ultra-viscous oils. Direct heating of any type of gas (e.g. propane, butane and natural gas) and any type of flammable fluid (e.g. gasoline, ethanol, aviation kerosene, industrial solvents) is also a popular application for this new technology. In short, the system is suitable for use in all industrial processes that require fluids to be heated either directly or indirectly.

## COMPETITIVE ADVANTAGE

The DIFHEMI system is safe because it operates with zero voltage between the mains and the equipment (because the tubular bundles are isolated from the

electrical system). It can be operated in hazardous areas, it needs no maintenance, it has no moving parts and it works 24/7, 365 days a year. It can operate at high temperatures and pressures, as well as at high powers.

Due to its compact format and modular installation, it can be installed near the place where heating is needed, saving space. The low temperature on the walls of the inner tubes avoids hot point, cracking, carbonisation or chemical alteration of the fluid to be heated.

There are no fluctuations in operating temperature, which means a constant temperature during the process. It is a dry working system and is cooled naturally. It's also free from generation of waste in the thermal fluid heating due to non-corrosiveness. This innovative system has been designed to offer complete safety for the operator and the whole process.

## IN SUMMARY

Taking into account the operational advantages of DIFHEMI described above, its makers believe it to be the most efficient and advanced heating equipment in the field of thermal engineering. Since 1983, DIFHEMI has been sold to more than 100 satisfied companies, including Saint-Gobain, Petrobras, ABB, Cargil, Rhodia-Solvay, Fiat, Kinross and many more. ■

*Mario Di Giulio invented DIFHEMI & Italo Bariola from AA Consultrade markets it worldwide*