Madis xL Ltd (formerly Madis Engineering Ltd) is a design and manufacturing group based out of Calgary, Alberta, Canada that now focuses entirely on the design and manufacture of induction heating systems for use in near-wellbore applications. These heaters greatly increase production rates in heavy and waxy oils while reducing water cut. Madis has also been involved in methane hydrate extraction, where MxL systems helped prevent rehydration in the tubing. MxL heaters have now been adapted for use with SAG-D operations, providing a steady, local source of heat to assist with the steaming function.

All MxL systems are custom-designed and can be retrofitted to existing wells, making them an ideal means of revitalizing wells that have “watered out” or otherwise seen a production decline.

Induction heating is one of the safest, most efficient means of prolonging a well’s lifespan. MxL heaters can fill a broad array of heating requirements, can be designed to work in a horizontal or a vertical configuration and can be optimized for numerous casing types.

*Right: MxL induction heaters are particularly effective on heavy oils. Induction heating dramatically reduces the viscosity of heavy fluids without affecting thinner liquids, so water flow will not be augmented but oil flow will.*
Globally Focused

Our ITA systems have made their way around the world, helping SAG-D preheat applications in Alberta’s oilsands, heavy oil extraction in the Middle East and South America, well revitalization in France and New Zealand, and methane hydrate experiments in the Pacific Ocean and the Canadian Arctic.
Why Induction?

Contrary to popular belief, electrical induction can be an extraordinarily efficient method of heat delivery. Unlike steam and chemical solutions that essentially need to penetrate the entire reservoir, induction heating can drastically alter the reservoir’s pressure gradient just by warming the near-wellbore. Nearly 80% of the available reservoir pressure is expended forcing oil through the area near the casing; viscosity reduction is greatest near the casing, which offsets the unheated pressure gradient. These improved conditions significantly augment oil flow.

Additionally, the temperature and pressure sensors in the MxL heaters make them valuable tools for well diagnosis and field testing.

As the oil flows towards the production zone, it is forced to follow a “tortuous path,” as illustrated above. This promotes a “wiping action” between the grains and the incoming fluid, maximizing heat transfer into the reservoir despite the direction of flow. In long term heating operations, we have observed that heat moves back into the reservoir at fairly predictable rates. Our PEPS software can determine and illustrate how the heat will propagate and eventually stabilize.

Our inductor designs can achieve higher than 90% efficiency. Because of this, the vast majority of energy put into the system will find its way into the reservoir. MxL systems do not require special completions; we have optimized systems to work with perforated casing, slotted liners, screen inserts and a number of other common completions. Electrical supply is provided via standard ESP cable banded to the tubing and the sensors return their information to the PCU via the ESP cable.
Never satisfied with a slow moment, Madis’ staff is always looking for ways to improve our products and services. Whether it’s software features, inductor efficiency or the MxL’s sensor array, R&D never stops. The manufacturing staff incorporates new ideas the moment they become viable and the electronics department is constantly refining our software calibration and circuit board designs. Many of our more experimental PCU features, such as “pump-off control,” data-responsive automation and flow switch integration, are ready for use in the real world.

Madis is currently accepting contracts so do not hesitate to inquire. Our contact information is contained on the last page of this document.

In early 2013, Madis employees rewrote our PEPS software to offer better models of horizontal wells. MxL heaters have been compatible with horizontal wells for some years, but we found many variables within the configuration that did not behave as we expected them to. Now, our PEPS software has been rebuilt to contend with the many surprises one can encounter with the configuration.

MxL systems can handily replace steam-based preheating, providing a steady source of heat rather than temporary blasts. And because the systems are electrical, there are very few side effects and no extra waste to deal with.

This flow switch features a custom-machined pipe fitting, making it appropriate for use in a non-standard tubing setup. This is one example of Madis’s willingness to adapt to client requests.
Part of the MxL's appeal lies in its scalable nature. Based on our preliminary examinations, we can determine how to best proceed with our manufacturing. Designers at Madis are constantly running research and development, finding the best configurations and power specifications for each unique well type. Because of this, the MxL system has seen an extraordinary number of applications in the real world, from heavy oil extraction to SAG-D preheat and natural gas production.
The Production Enhancement Projection Software (PEPS) developed in-house plays an integral role in our heaters. Featuring an exhaustively modeled recreation of common substrates and reservoir characteristics, the software offers a visual and numerical illustration of how heat will propagate into a well over time.

PEPS allows Madis to determine optimum heat output, inductor configuration and system length. In order to benefit from induction heating, a well requires certain reservoir pressure characteristics. PEPS software makes it possible to predict whether it is worth moving forward with a project.

PEPS modeling is inexpensive and reliable, making it the ideal first step with prospective clients.

Once the system has been designed and installed, it relays data back to the PCU. MxL heaters contain sixteen temperature sensors distributed along the tool length, providing localized data and allowing us to deliver heat where it is most needed. The Visual Presentation Software takes this raw data and converts it into an easy-to-read chart.

Data can be transferred from the PCU to an SD card for examination, and we can outfit the PCU with a wireless modem or satellite uplink so that the data can be accessed remotely. Madis technicians can examine the PCU data from our office in Calgary and offer insight and advice to the people on site.
Success in the Alsace

Madis Engineering first began our work with Philippe Labat and OELWEG SARL in 2005, after SARL’s attempts with a different company’s resistance heater provided less-than-satisfactory results. The well had initially produced around sixty barrels of oil per day but had steadily declined to only two BOD. Within sixty days of the MxL’s installation, the well’s output had increased to eighteen BOD. Unfortunately, we had to remove the heater following a tubing leak in 2006.

Madis replaced the SARL heater in 2011, installing a much larger system with better diagnostic capabilities. Production tripled inside of only a few months and the heater has been running for nearly three years without issue.
Back in 2008, Madis Engineering was involved in a series of experiments designed to determine whether methane hydrate was a viable energy option. Aurora Research Institute, Natural Resources Canada (NRCan) and the Japan Oil, Gas and Metals National Corporation (JOGMEC) conducted the experiments, and the heating technology designed by Madis Engineering played a vital role in the project's success.

Methane hydrate, colloquially known as “flammable ice,” is one of the most abundant natural resources on the planet. Unfortunately, most of the reserves are located in the ocean floor, making their extraction a difficult and expensive endeavor. Methane hydrate has ice-like characteristics due to the tremendous pressure surrounding the reserves, but scientists determined that if the pressure of the reserve is lowered, it is possible to harvest the natural gas in an efficient manner.

Preliminary tests proved successful, but because the materials are so highly pressurized, the production tubing was at constant risk. Madis Engineering designed, manufactured and operated a custom MxL Heating System for the Beaufort experiments. Our system's purpose was to prevent the extracted gas from reforming into gas hydrate as it rose towards the surface, thus plugging the tubing and halting production.

The MxL Heater consistently kept the borehole fluids between 20 and 30 degrees Celsius, effectively eliminating the risk of ice formation in the production tubing and contributing to the first successful extraction of methane hydrate in Canada.

Since then, Madis has continued to explore the role our system could play in natural gas extraction. Constant research and development led us to design an entirely new induction core, allowing for increased heat output per meter. Oftentimes offshore drilling rigs will have severe power limitations, so we optimized our system to work with a delta-configuration input source as well. Each section of our heater has a number of temperature and pressure sensors, allowing the extraction team easy access to vital information and giving them the ability to monitor down-hole conditions on a minute-to-minute basis.

Madis completed work on our full-size deep-sea heater in late 2012, lending our expertise to JOGMEC’s first large-scale attempt at extracting methane hydrate from the seas surrounding Japan.
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