



MORGAN MKV RECUPERATIVE CRUCIBLE FURNACES

PERFORMANCE BENEFITS CONTINUED...

COST EFFECTIVE

The new technology incorporated into the recuperative system makes it the most cost effective product of its kind. The new recuperative technology has shown a minimum of 35% energy reduction, over conventional gas fired furnaces. At some foundries savings as high as 50% in gas usage were obtained, compared to their existing firebrick lined gas-fired furnaces.

The cost savings achieved by more efficient use of gas from the new recuperator technology are enhanced by incorporating the very latest refractory and insulation technology into the furnace design. Using the latest materials technology, the highest level of crucible thermal conductivity available commercially is obtained, which minimises heat losses from the furnace stack. Melting efficiencies as high as 40% are achieved, compared to conventional gas-fired crucible furnaces, where 20-25% is more typical.

The MKV recuperative furnace also delivers more cost effective running costs in terms of longer consumable life. Crucible life is enhanced due to the fully modulating burner technology, which has two advantages in terms of crucible life. Firstly it burns very close to stoichiometric combustion, so that no excess oxygen is present in the furnace chamber, which would otherwise attack the high graphite and carbon content of the crucible causing oxidation. Secondly it introduces a high velocity gas stream into the chamber, which creates an even heat distribution over the whole crucible, ensuring no hot spots exist that would otherwise cause thermal stresses, leading to distortion. This highly efficient thermal design feature is further enhanced by the hot face chamber lining, which incorporates Morgan's patented gas radiant panel technology, which radiates heat directly onto the crucible and thereby to the metal, rather than traditional brick designs, which allow more heat to be lost to the stack as waste.

The new integrated recuperative furnace design also facilitates fast commissioning times, minimising foundry downtime, if replacing a non-recuperative unit. Traditional recuperative designs are constructed using separate floor mounted components, with gas pipes trailing across the foundry floor. This leads to long and complicated installation & commissioning times and presents health and safety risks to the operator and risk of damage to the critical components from fork lift traffic in the foundry.

OPTIMUM METAL QUALITY

The same technological features that minimize the running costs of the new recuperative furnace also contribute to delivering optimum metal quality. The fully modulating, high turn down ratio burner gives tight control of metal temperature typically down to $\pm 5^{\circ}\text{C}$

or better, allowing foundries to achieve the stringent quality controls required for modern automotive castings, reducing rejects and minimizing costly metal losses. The gas flow design is such that the exhaust gases exit from the side of the chamber, not over the top of the crucible, ensuring that gases do not contact the molten metal, thus minimizing the potential for gas pick up which would otherwise lead to porosity in castings.

HEALTH, SAFETY & THE ENVIRONMENT

With operator comfort and safety in mind the highly efficient insulation which helps minimize running costs also ensures that casing temperatures are low and that the ambient temperature of the working environment is as comfortable as possible. The unique burner design also reduces noise levels during use of the furnace to unparalleled levels, with under 75dBA measured at 2m from the unit, which is below current regulations for the UK requiring PPE action.

The new burner technology utilised in the MKV recuperative crucible furnaces, also have the added benefit of reducing 'greenhouse' gaseous emissions. Typical CO2 emissions for a BT1300 size furnace are reduced to ~12 tonnes per year compared to ~20 tonnes per year for a non-recuperative equivalent furnace run under the same conditions. Raising the temperature of the input air by recuperation also raises the level of NOx generated, such that conventional recuperative forced air burners run above 400ppm. Input air is typically pre-heated up to 250°C in a recuperative crucible furnace. Under these conditions the MKV recuperative burner technology reduces NOx emissions below 125ppm.

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MOLTEN METAL PRODUCTS

FOUNDRIES SAVE MONEY

Initial foundry trials of the new recuperative technology began in the early 2000s in the UK, where the technology was developed, but this furnace technology is now being utilised successfully in many markets around the world. In our work with foundries across the world, typically, a project to optimise their melting and holding practices will start with a detailed audit of the foundry's existing capabilities and a comparison with their energy costs, working practices and alloy demands. To complement the recuperative technology we have developed a series of analytical tools which can help the foundry identify where it can save money on its gas bills. Invariably, the biggest potential saving identified is replacement of the existing furnaces with the new recuperative furnace technology. Depending on the state of the furnaces they are replacing and the gas price, it is not uncommon for a foundry to find that the investment in new recuperative furnaces is paid for within two years just by the reduction on their gas bill. On top of this, there is often additional financial support available in terms of government grants and loans available to support energy saving and carbon footprint reduction schemes. In the UK the Carbon Trust provides loan schemes to help fund the purchase of energy efficient capital equipment to reduce carbon emissions. Similar schemes are available in a number of other countries.

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INTRODUCTION

Energy costs are continually rising and they represent a high proportion of any foundry overall costs. Gas has historically been the lowest cost energy source for melting most metals and alloys up to 1000 degrees centigrade and now with the benefits of "recuperation" significantly lower costs can be enjoyed over typical gas fired furnaces. The Morgan MKV gas recuperative furnace, manufactured by MMP Ltd, in the United Kingdom, offers the "state of the art" in both bale out and tilting crucible furnaces, covering a wide range of capacities and melting performance.

BACKGROUND

Fuel prices have been rising at a rapid rate in recent times and foundries everywhere are finding it increasingly difficult to remain cost effective & competitive. So foundries are looking to significantly reduce their energy consumption in order to remain competitive.

Molten Metal Products Ltd are suppliers of Morgan crucibles and manufacture the Morgan range of crucible furnaces from their UK operation. Morgan developed a leading position and enviable reputation in the market worldwide and this continues from the dedicated team at MMP. They continue to offer, truly integrated crucible based metal melting & holding systems. This is because it supplies optimally matched Morgan Recuperative Gas Fired Crucible Furnace crucibles and furnaces. MMP understand that optimising the performance of any metal melting and holding process in the

foundry is dependent on balancing a complex set of variables. The furnace, customer working practices, crucible and metallurgical processes all interact. So to achieve the balance required, the system needs application specific design, for both the consumables and the equipment.

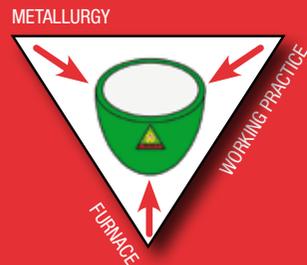
From this technological background, Morgan and now MMP have addressed the concerns that foundries had expressed about their rising fuel bills. The outcome was a furnace that used fuel in a much more efficient way and significantly reduced foundry fuel costs. It was achieved by looking at our existing technology and how that might be redesigned and made more energy efficient.

Recuperation on furnaces is not a new concept, having been around since the early 1900's. Take up of the



Gas Fired Crucible Furnace

technology accelerated during the 1970s oil crisis, which created similar problems with rising energy costs and supply restrictions as we are experiencing today. Morgan were quick to respond to the situation and developed a range of crucible furnaces incorporating a recuperation technique that would utilise fuel more efficiently. To address the fuel crisis of current times, recuperation was re examined and improvements made to the efficiency and cost effectiveness of the technology to breathe new life into recuperative systems.



SO WHAT IS RECUPERATION?

A "recuperator" recycles waste heat from the exhaust gases to pre-heat the combustion air to the burner. It achieves this via a counter-flow heat exchanger which on a crucible furnace replaces the standard exhaust stack. The recuperator transfers waste heat in the exhaust to the combustion air entering the fuel burner, thus preheating it. Since the gases have been pre-heated, less fuel is needed to heat those gases to the required furnace melting/holding temperatures.

The recuperator technique is used for heat recovery in many other industries, such as chemical plants and refineries, in applications where there is fluid-fluid counter flow and in closed system processes such as in refrigeration cycles. There are several other systems of heat recovery available including the regenerative heat exchanger, the rotating recuperator

and energy recovery ventilation, but the standard recuperator is the system that works best with fuel burner applications, to increase the overall efficiency, and for this reason is used in gas turbine engines.

By recovering some of the energy usually lost as waste heat, the recuperator makes a fuel fired crucible furnace significantly more efficient. Morgan's unique position as a designer of both furnaces and crucibles allowed us to significantly enhance the efficiency of the design of the recuperative system as applied to fuel fired crucible furnaces, through optimal selection of materials and components and true integration of design. Instead of just bolting a recuperator system onto an existing furnace, we understood that optimum efficiency would only come by starting from first principles, and so we set out to create a design which truly integrated the recuperator with the furnace and the crucible. The result of this development work is the new range of Morgan Recuperative Furnaces, available as both static bale out and as tilting systems to provide foundries with the lowest gas bills possible at both the casting and melting stations.



Gas Radiant Panel



Integrated Design

PERFORMANCE BENEFITS

Due to the integrated design, the Morgan, MMP, range of recuperative furnaces, hosts a range of benefits to the foundry far beyond the key advantage of lowering their gas bill;

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