MCK Metals Pacific Ltd

Submerged Mixer Impact Report

Location: Paraite Rd, Bell Block, New Plymouth
Owner: MCK Metals Pacific Ltd
Date: 4th July, 2008
By: Warwick Brown

Summary

The one month trial in April 2008, of the mixer on the gas fired aluminium melting furnace, produced a 6.8% saving in gas energy consumption for MCK Metals Pacific Ltd. At 880 tonne monthly melt rates, savings of 561 MJ/ tonne were realized solely due to the operation of the mixer on the gas-fired aluminium-melting furnace. If well maintained and operated, it is reasonable to expect similar savings in future months.

Background

In January 2008, MCK Metals Pacific Ltd fitted a molten metal stirrer to its gas-fired aluminium re-melt furnace to enhance the furnace efficiency. Independent Technology Ltd has been commissioned by EECA to review the furnace energy usage and report on the impact of the installation.

Site installation

The re-melt facility consists of two furnaces: A small electric coreless-induction furnace and a large gas-fired reverberatory furnace. The electric furnace melts and supplies molten metal to the gas-fired furnace. The gas-fired furnace independently melts metal and, combined with molten metal from the electric furnace, supplies the casting station. The molten metal stirrer is fitted to the side of the gas-fired furnace.

Gas-fired furnace

The gas-fired reverberatory furnace uses roof mounted burners to heat the air and refractory above a shallow bath of metal. The reflected heat melts the initial metal charge to form a bath of molten metal. The combined hearth heat and molten pool melt further charges of metal.

The rate of transfer of energy from the hearth hot gas to the molten pool below, is dependant on the relative difference in temperatures. Colder metal located at the bottom of the pool, is difficult to heat without mixing.

Opening furnace doors to allow access for mechanical mixing allows hearth heat to escape. The installation of the stirrer enables, with furnace doors closed, the colder metal at the bottom of the molten pool to be exposed to the hearth heat above, enhancing heat transfer and furnace efficiency.

Efficiency analysis detail

The two furnaces were operated for four consecutive weeks without the mixer, followed by a further four weeks, with the mixer, to ascertain the impact on energy efficiency.

No mixer Feb/08-Mar/08	Mass of aluminium melted/heated (tonne)		Energy used (GJ)
Electric furnace	322.0		732.4
Electric furnace efficiency			@ 55%
Electric furnace contribution to melt	322.0		402.8
Gas furnace energy consumption	719.58		8,198.9
Combined energy consumption	1,041.54		8,601.7
Energy consumption rate:	**8.26**	GJ/tonne	
With mixer Mar/08-Apr/08			
Electric furnace	254.5		725.0
Electric furnace efficiency 55%			
Electric furnace contribution to melt	254.5		398.8
Stirrer motor energy consumption			3.9
Gas furnace energy consumption	626.9		6,381.4
Combined energy consumption	881.4		6,784.1
Energy consumption rate:	**7.70**	GJ/tonne	
Reduction in energy usage	**6.8 %**		**- 0.56** GJ/tonne
Expected energy saving based on Mar-Apr production levels			**562** MJ / tonne

Error analysis

Influence of the electric furnace

The electric furnace efficiency has little influence on the overall proposal as its consumption represents only 9% to the total foundry energy usage. This report assumes the energy efficiency of the electric furnace to be within the range 50-60%. Assessing for both 50% and 60% shows the potential impact for the extent of the % range.

Energy savings with the electric furnace efficiency at 50%.

Without mixer Feb/08-Mar/08	Melted/heated (tonne)		Energy used (GJ)
Electric furnace	322.0		732.4
Electric furnace efficiency			@ **50%**
Electric furnace contribution to melt	322.0		366.2
Gas furnace energy consumption	719.6		8,198.9
Combined energy consumption	1,041.5		8,565.1
Energy consumption rate:	**8.22**	GJ/tonne	

With mixer Mar/08-Apr/08	Melted/heated (tonne)		Energy used (GJ)
Electric furnace	254.5		725.0
Electric furnace efficiency			@ **50%**
Electric furnace contribution to melt	254.5		362.5
Stirrer motor energy			3.87
Gas furnace energy consumption	626.9		6,381.4
Combined energy consumption	881.4		6,747.8
Energy consumption rate:	**7.66**	GJ/tonne	
Reduction in energy usage	6.9%		**- 0.568**
Expected energy saving based on Mar-Apr production levels			**568** MJ / tonne

Energy savings with the electric furnace efficiency at 60%.

Without mixer Feb/08-Mar/08	Melted/heated (tonne)		Energy used (GJ)
Electric furnace	322.0		732.4
Electric furnace efficiency			@ **60%**
Electric furnace contribution to melt	322.0		439.5
Gas furnace energy consumption	719.6		8,198.9
Combined energy consumption	1,041.5		8,638.4
Energy consumption rate	**8.294**	GJ/tonne	
With mixer Mar/08-Apr/08			
Electric furnace	254.5		725.0
Electric furnace efficiency			@ 6**0%**
Electric furnace contribution to melt	254.49		435.0
Stirrer motor energy			3.87
Gas furnace energy consumption	626.88		6,381.44
Combined energy consumption	881.37		6,820.32
Energy consumption rate:	**7.738**	GJ/tonne	
Reduction in energy usage	6.7%		**- 0.556**
Expected energy saving based on Mar-Apr production levels			**556** MJ / tonne

Influence of gas meter accuracy.

The meter used is of a turbine type with an expected accuracy of plus or minus 5%. Any error variation would be consistent for all the readings taken and therefore the impact on the overall efficiency is negligible.