As seen in Glass Worldwide Magazine

This article further expands on the excellent recent articles by Stuart Hakes of FIC and Richard Stormont of Electroglass (published in Glass Worldwide issues 25 and 26) regarding the use of electrical heating / boosting to augment and in many cases improve the overall energy efficiency of various glass production processes. It will expand upon additional concepts to improve the electrical efficiency of the electrical melting / heating systems and also reduce installation costs.

Through much investigation into various glass electrical, heating, melting and boost systems it can be seen that the majority of these systems use air cooled, and in some instances, oil-cooled transformers. For reasons such as high ambient temperatures, limited space, dirty environments, safety etc. the air / oil-cooled transformers are generally installed at long distances from the furnace or heating elements they are connected to. The distances can vary from 20 to 250 metres away.

Due to the application voltages and high currents required for most electrical melting, heating and boost applications, large, long copper bus bars and cables are required to get the electrical energy to the work. The cost of these copper bus bars including installation, isolation and maintenance can be substantial. The volatility in copper prices can also cause difficulty for estimation and installation costs.

The requirement for the long copper bus being added to the system causes voltage drops due to resistance and reactance losses. These losses (voltage drops) drive primary power demand up for the entire system. In many cases an alternative system using compact, fully encapsulated water-cooled transformers can replace an air / oilcooled system (see Figure 2). The water-cooled transformers are only a third to a quarter of the size of the equivalent air / oil-cooled models. This means water-cooled transformers can be located (closely coupled) to where the work is being done – in many cases as close as 1-20 metres.

Due to complete encapsulation and water cooling, the water-cooled transformers can withstand a very dirty and high ambient temperature environment. The close proximity to the work also means the use of smaller and much shorter copper bus and cables to connect to the electrodes or other heating elements such as platinum, silicon carbide etc.

The reduction in secondary bus length, depending on secondary voltage and current requirements, can offer substantial equipment and electrical savings of 5-40%. The smaller size of the watercooled units can also offer installation benefits such as saving space, being easier to move, less structure required to mount them due to much lower weight etc.

It is important to point out that water-cooled transformers are not totally new to the glass industry, however most water-cooled transformer designs originally spawned from air-cooled models and were not very efficient at heat transfer, and were quite large and used high volumes of water. The newest water-cooled transformer designs are much smaller, have high heat transfer and use special insulation and manufacturing techniques that allow these new cost-saving application possibilities. Typical water consumption for a 60-300 KVA high efficiency boost / melting transformer is (4-7.5 LPM) with a delta pressure drop of under (.8-Bar) input water temperature of 30-35 degrees celsius.

The close coupled water-cooled solution is not for all applications, but investigations and applications over the last few years have shown savings possibilities in over 75% of the glass applications accessed. With increasing energy costs and new corporate commitments by many large glass manufacturers to reduce their global energy footprint, this concept can offer substantial savings. Most systems also have a ROI (return on investment) of 12-24 months.

Figure 1:
Closely-coupled, small water-cooled transformers mounted 5-15m from process

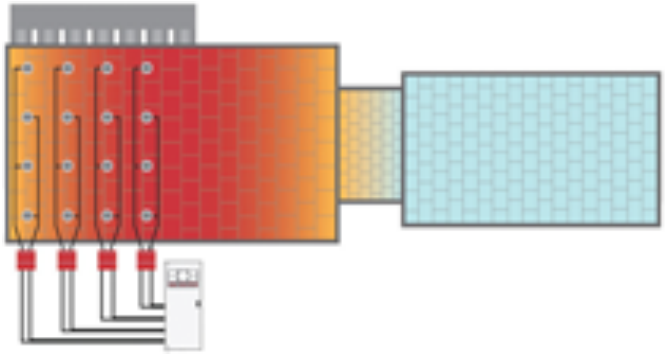

Figure 2:
60 KVA water-cooled transformer for direct or indirect heating