MODELLING AND SIMULATION

Automotive glazing modelling

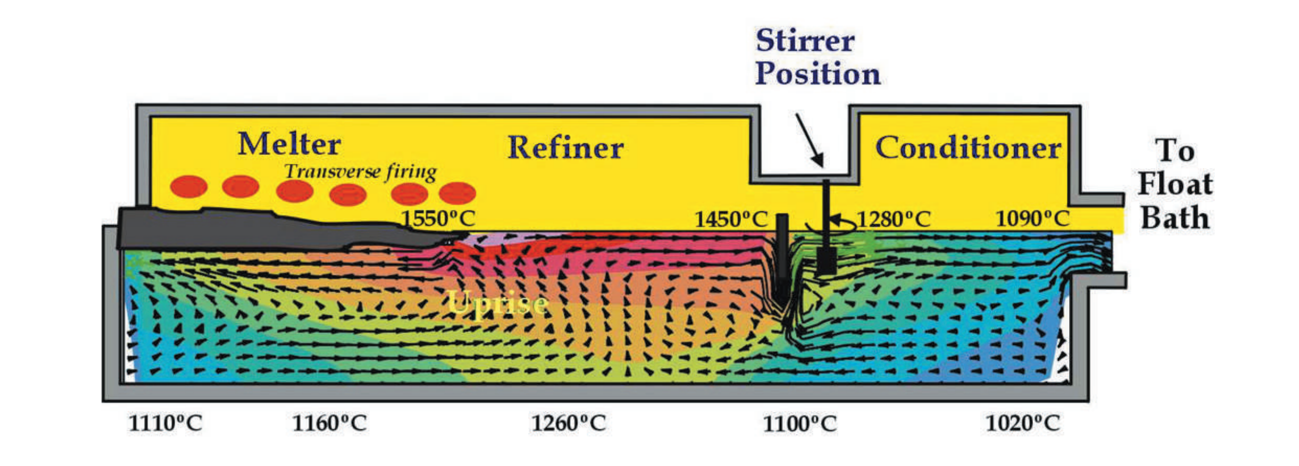
Process development experiments can be expensive and time consuming to perform on a full scale manufacturing plant; because of this the use of computer modelling and simulation is key to our process development activities. This modelling ranges from the simulation of fuel combustion in the glass melting process, through glass flows in the furnace to calculation of heat flows in bending of automotive glasses to the determination of stresses in glass components e.g. architectural, automotive and aerospace glazing. Our modelling and simulation capabilities are a key component of a cost effective continuous process improvement process.

Surprisingly, even with the power of modern computers, the details of the flows of molten glass in glass furnaces can become too difficult to simulate adequately by purely mathematical means.

We therefore use physical models in parallel with computer models to investigate these flows. We are one of the few major glass manufacturers to have this valuable physical modelling capability. These transparent models are operated at room temperatures with dimensions and liquids scaled to mimic the flows of molten glass in full scale float furnaces: dye droplets are used to visualise the flows. The models are valuable not only in process development work but in communication with plant managers where the effect of proposed plant changes can be readily visualised.

The track a particle or bubble can take during the glass melting process is complicated, being driven by the mass flows, chemical reactions and temperature profiles in the furnace. Simulation of these tracks is key to improving the efficiency of the process. Computer modelling has the advantage that changes to the model, for example in furnace design, can be easily made, their effects on glass flows readily observed and the production of homogeneous virtually bubble free glass from the exit end of the process or forming on the tin bath achieved. Such modelling is not limited to flows in glass: the dispersion of plumes from float plant chimneys can be simulated taking into account local geography and climate. We can therefore be assured that a new plant will operate within strict environmental pollution limits before it is built.

At the glass component level computer simulation of the glass bending process is a critical precursor to any practical development work on new automotive glazing shapes. Finite element techniques are used to predict any buckling or wrinkling which may occur during the bending process and suggest changes to the design or process which will overcome these problems. Undesirable optical effects such as double imaging and distortions which occur both from the original design or the manufactured shape can be simulated and designed out. This work allows the glazing manufacturer and car designer to closely interact early in the development of a new vehicle and agree on a feasible component design before development trials begin.



Cross section of a float furnace showing glass flows

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