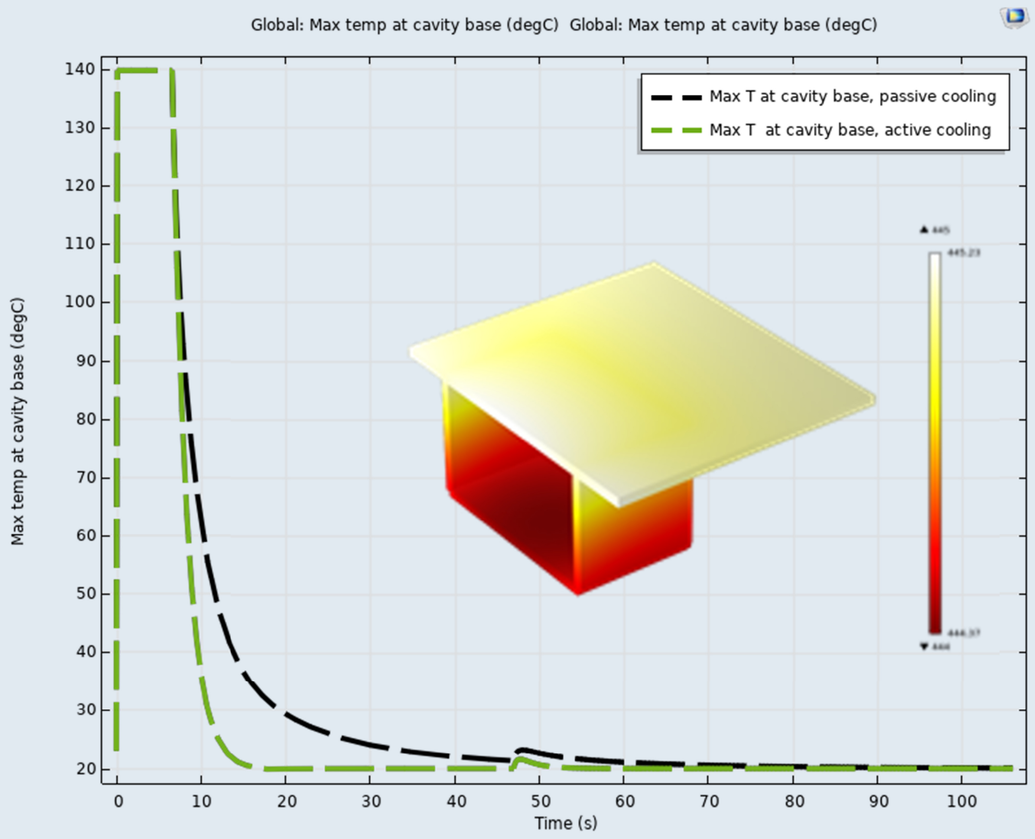

Using COMSOL® in a Connected Virtual Factory: Thermal RSM for Rapid Adaptable Packaging

The manufacturing of a tablet blister cavity is thermally modelled (forming and lidding). A surrogate model was developed and connected to a process flow model.

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Introduction & Goals

Careful temperature control is required during pharmaceutical product handling to prevent quality issues during packing. As part of the Digital Manufacturing Accelerator (DMA) project, a demonstrator was developed for a rapidly reconfigurable factory environment (RRFE) of a tablet blister packaging process with quick changeovers. To support this, a Virtual Factory (VF) was created in tandem in which we model inline blister temperature control. When used as a surrogate model in the virtual workflow, it enabled control decisions to be made, i.e. to action active cooling or extend the cooling wait period depending on priorities. This was developed as part of one of two dual physical/virtual demonstrators for the DMA, whereby a physical packing line has been commissioned in our Liverpool facility to enable the industry to reconfigure the system both virtually and physically for a range of different tablet-based products.

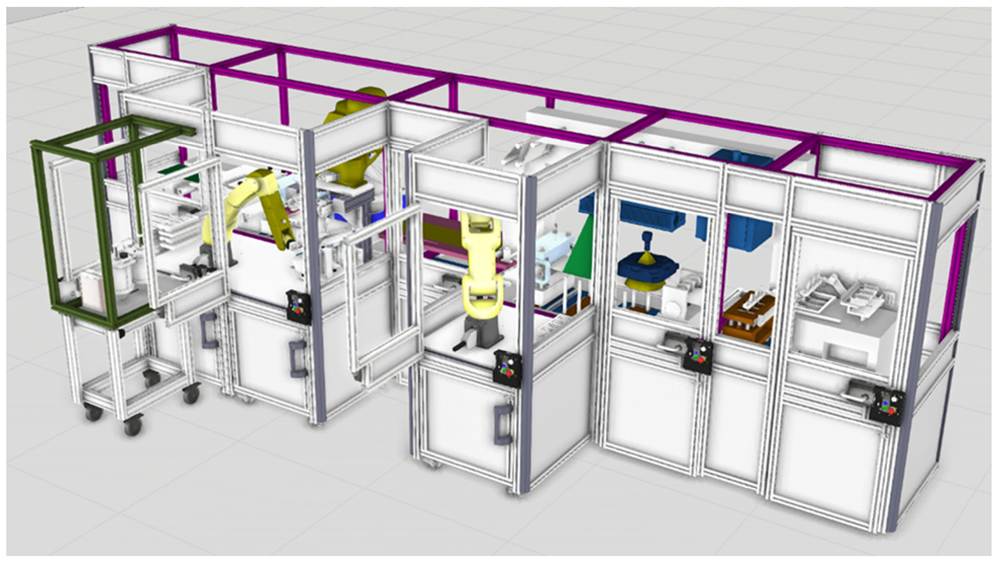

Figure 1. Rapidly reconfigurable factory environment: pharmaceutical packaging line

Method

The tablet blister cavity is modelled in 3D, utilising the heat transfer in shells physics interface. The cavity lid is modelled using a layered material (see Fig.2) to represent the thin aluminium lidding that is sealed on top. Events take the geometry through its thermal evolution as the lid is 'applied', recording when critical temperature limits are exceeded and enabling cooling times to be extracted by default.

Using a workflow manager, this was incorporated with others as sub-models to provide a result dataset from the VF that formed an RSM. This, in turn, was then used as a surrogate to provide predictive temporal and thermal information based on inline sensor data from the RRFE line to enable a control action to be taken by operators.

Further Use

Initial timings are input from a separate process flow model, and the model is run to give temperature profiles for each timing set. The model returns thermal data for all surfaces of the blister cavity in the form of 3D surface temperature plots or 1D temperature plots for specified probe points covering KPIs over time.

Following this, either suggested timings can be fed back to the process model through a workflow manager, or an operator can determine if forced cooling is required. Beyond this, using several sets, a response surface model was created to provide a surrogate model when used with input data from the physical line to enable proactive control without running full simulations each time.

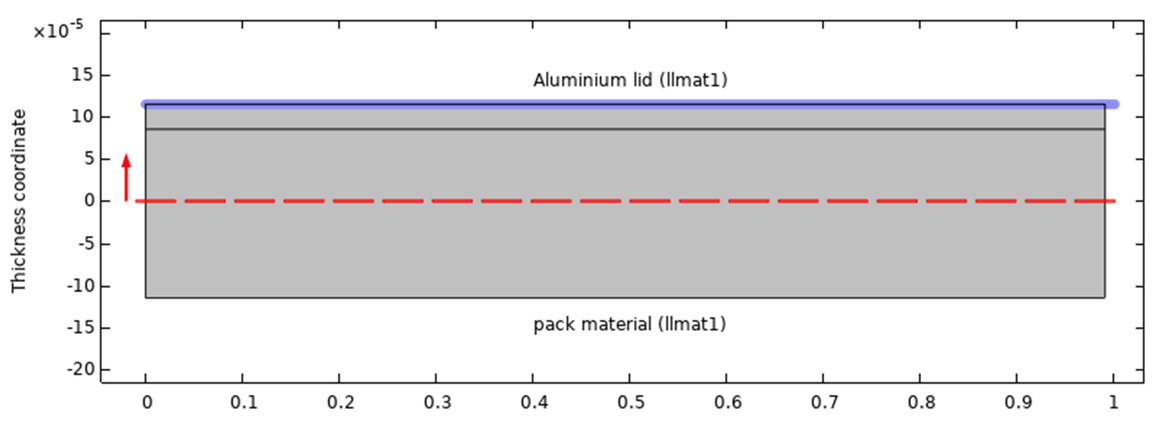

Figure 2. Layered material representation for tablet blister pack

REFERENCES

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