



More Efficiency

through Virtual Cold Chain



- Virtual Box Design
- Virtual Box Testing
- Generating Representative Temperature Profiles
- Statistical Analysis of Lane Temperatures
- Lane Risk Analysis



The picture above shows all the over 20.000 accessible weather stations we have at hand to generate thermal profiles.

Who is SmartCAE?

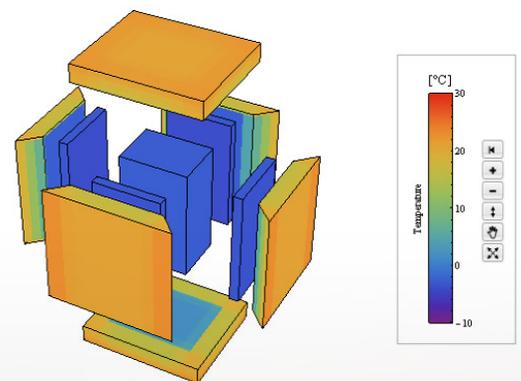
SmartCAE is a specialized team of thermal experts. We are developing intelligent simulation tools, algorithms, and also provide consulting services.

Our software solutions are easy to use featuring short computation times of a few minutes on a conventional laptop. Our simulation tools help you when making important decision during a meeting. SmartCAE has developed a simulation environment which consists

of the software **SmartCAE Temperature Profiles** for weather data and **SmartCAE Thermal Packaging** for thermal simulation of passive shippers. All possible temperature ranges can be considered such as -80°C , -20°C , $2 - 8^{\circ}\text{C}$, and CRT.

What does SmartCAE do?

- Virtual Box Design
- Virtual Box Testing
- Generating Representative Temperature Profiles
- Statistical Analysis of Lane Temperatures
- Lane Risk Analysis



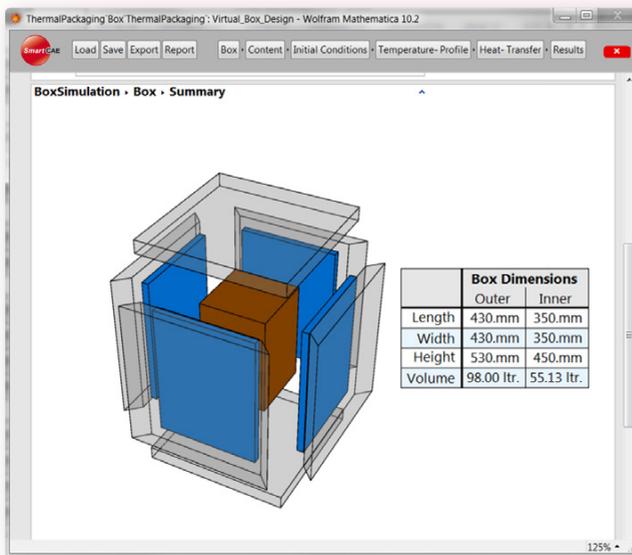
Explosion sketch of an exemplary shippo as it is used in our software **Thermal Packaging**

● Virtual Box Design

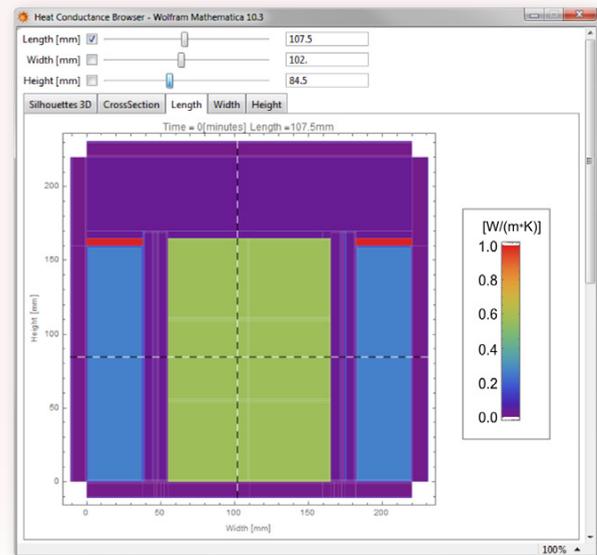
In the software **Thermal Packaging** you can create a virtual version of boxes in your portfolio. By using thermal simulation we support you in building a cost effective insulated packaging that is optimized for your purpose. This will save time and money in the early

stage of the concept phase when designing your box, by optimizing its weight and volume and the weight of the required coolants. The virtual approach also enables an explorative out-of-the-box thinking and brings a higher level of confidence into the design process.

Box configuration

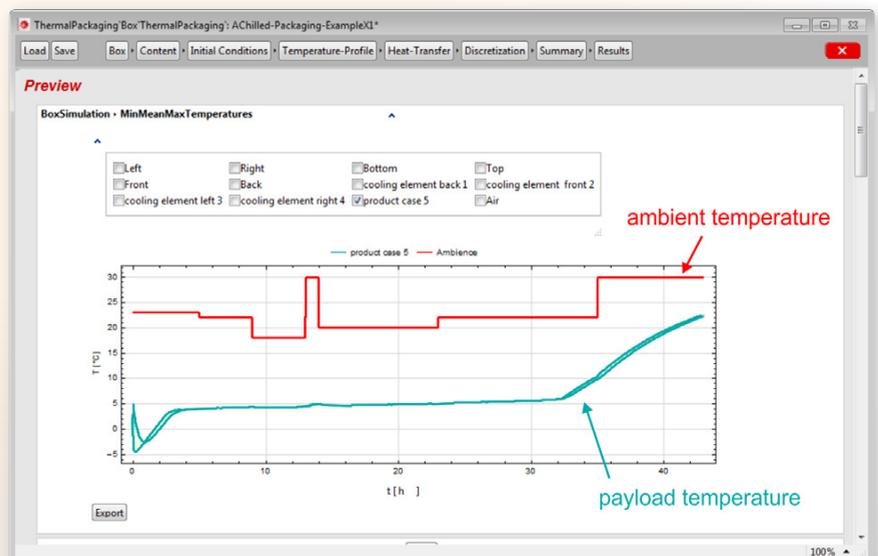


Heat conductivity



● Virtual Box Testing

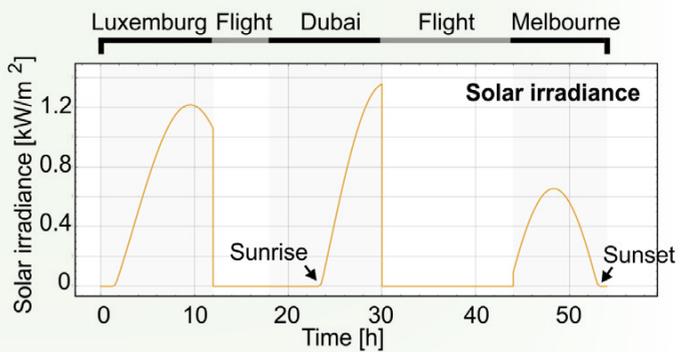
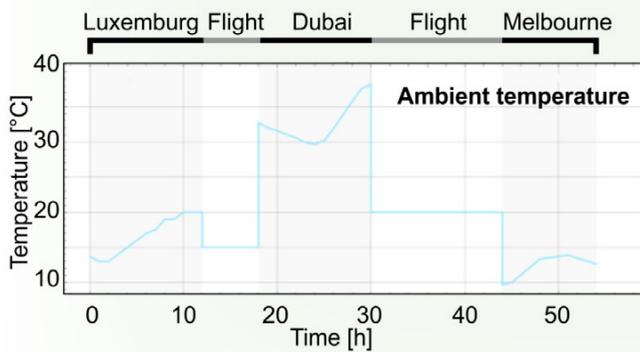
You can test each virtual box against ambient temperature profiles specified by your individual requirements. Testing a virtual box allows for an identification of critical temperature profiles and in this context identify risks for box failure. You can also investigate other effects on the box in a controlled manner, such as the solar irradiation or tarmac temperature. At the end of the day this will minimize the number of physical tests required to characterize your boxes.



● Generating Representative Temperature Profiles

Our SmartCAE **Temperature Profiles** software delivers historical weather data from around 20.000 weather stations all over the world.

You can generate a representative temperature profile for your shipping lane and also add the solar radiation depending on the location.

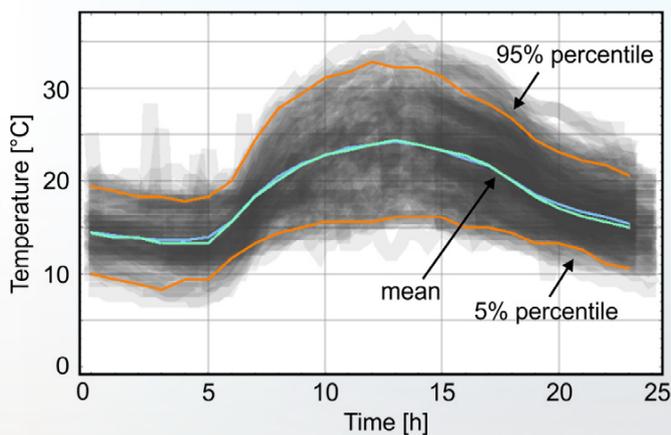


● Statistical Analysis of Lane Temperatures

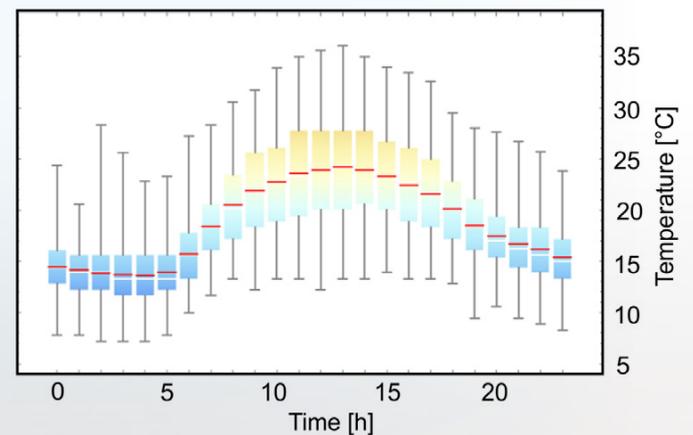
Using our software **Temperature Profiles** you are able to create a large number of temperature profiles. This catalogue allows you to statistically eval-

uate the set of ambient temperature on a lane and study its implications for temperature controlled logistics.

Historical temperature data



Statistical representation of lane temperature

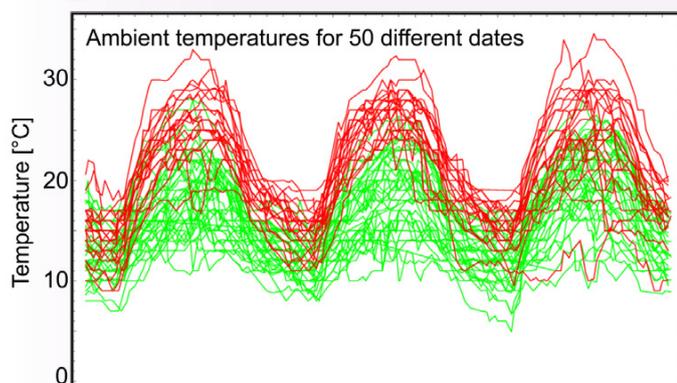


● Lane Risk Analysis

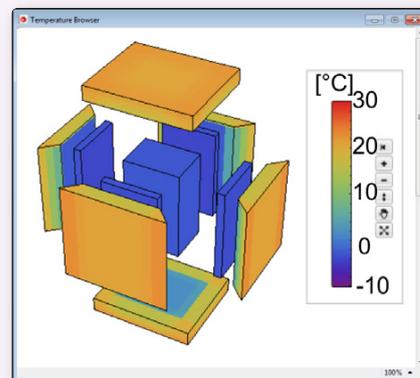
For our risk based approach we create ambient temperatures by using historical data provided by our software Thermal Profiles. The software has access to more than 20.000 weather stations worldwide. We apply all generated temperature profiles

on a predefined box to obtain the thermal behavior of the payload. Based on that information we get a failure percentage of the box. The cumulative distribution function (below) shows the percentage of failure after a certain amount of time.

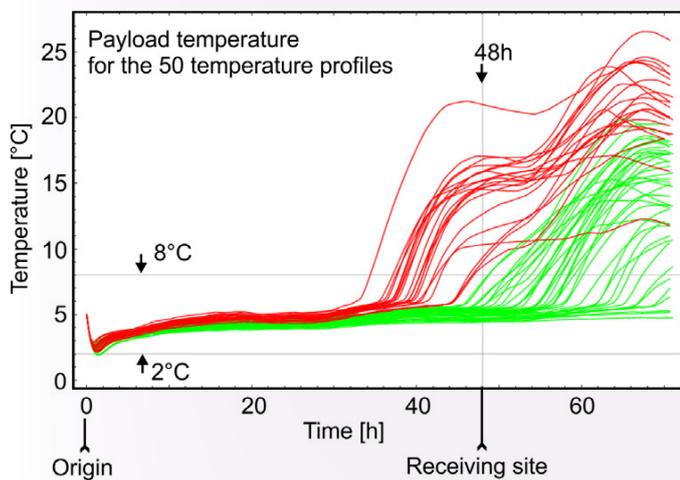
① Setup ambient temperature ...



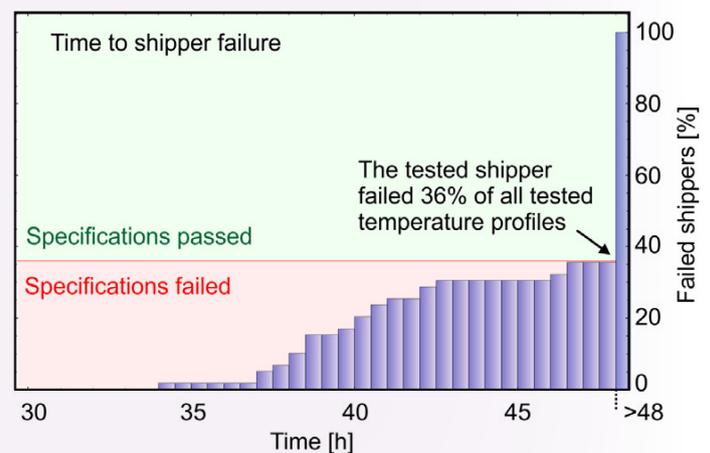
② ... and virtual shipper



③ Simulation result: payload temperature ...



④ ... and shipper failure percentage



From left to right:

- ① An ambient temperature profile covering a set of real life historical data.
- ② An explosion sketch of a shipper.
- ③ The simulated temperature read out of the shipper when exposed to a set of ambient temperature profiles:
 - red → shipper has failed its specifications
 - green → shipper has passed its specifications
- ④ Statistical evaluation of the thermal behavior of the shipper.



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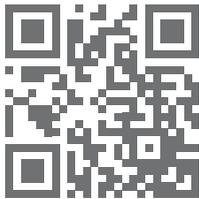
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