

Maths milks it!



Mathematics and applied mathematics are used in everyday life. Stock markets, mobile phones, car manufacturing, Google, Hollywood special effects, digital TV and satellites all use cutting-edge mathematics tools in their basic functions. The Mathematical Modelling Series presents a number of applications of mathematics in domains as varied as the human body, volcanology, telecommunications or finance.

The fresh milk you drink in the morning has been through a number of processes before reaching your glass or cereal bowl. Farmers store the milk from their cows in big tanks where it is collected by the milk processing company, which treats it, packages it and distributes it to the shops. For all those involved in this process, it is important to know precisely how much milk is collected from the farmer's tank. This is done automatically during collection of the milk, but the process is not very accurate (although the same process works perfectly with water). Why is it different with milk?

How it works

Milk is pumped from the bottom of the farmer's tank to the tanker truck. This takes a few minutes to transfer. At first, everything runs smoothly and the behaviour of milk is very similar to the behaviour of water. However, when the farmer's tank is nearly empty, some air is also sucked in by the pump. This air takes the form of small bubbles when mixed with the milk (very much like in a cappuccino machine). This foam,

which would not form with water, is counted as milk by the measuring device on the tanker truck, and this is why the volume measured is not accurate.

Mathematics can help to solve this industrial problem. A set of equations can be calculated to describe the movement of the milk in the tank and the evolution of the bubbles in the milk. Several devices can then be installed to reduce the formation of foam.

Conclusion

When milk is collected, the tank behaves like a giant cappuccino machine and a layer of foam develops at the top. Limiting the formation of this foam will significantly increase the accuracy when measuring the volume of milk in the tanker truck.

Parts of the curriculum used in this project:

- Differentiation
- Integration
- Trigonometry
- Newton's second law
- Archimedes' principle
- Ordinary differential equations

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If you want more information about MACSI and this project:

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