Energy-Mass Balance Analysis of a manufacturing process for the wristband in a silent alarm device

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Project: Silent Alarm
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Context

Our silent alarm group visited the Buttercup Bakery on September 18th, which is a factory that bakes and packages bread. It was interesting to see how all the machinery "works together" to create the end product of a loaf of bread from a lump of dough. There seemed to be a lot of wastage though; I must have seen about 10 loaves be thrown out because the "bagging" machines did not properly bag the cut loaf of bread! And on a wall inside the factory was a large sign saying that the factory was aiming to keep wastage down to 0.6%. This wastage is relevant to the topic *Energy-Mass Balance Plan* because it would be part of the factory's mass or material balance. If our silent alarm device was to be mass produced like bread is, it would be extremely important to analyse the energy and mass flows in the manufacturing process (and during operation) in order to minimise both energy and material consumption (thus costs), and design the system to be as [energy] efficient as possible.

Purpose or Goal

Analysing the energy and mass flows of just one part of our silent alarm system (a possible manufacturing process of the wrist/arm band) will be critical to better understanding these flows throughout the entire silent alarm system, during both production and operation. My research will be submitted as a paper, not as a poster.

Approach

I am going to look at a paper (*The 1.7 Kilogram Microchip: Energy and Material Use in the Production of Semiconductor Devices* by Williams *et. al.*) that outlines certain energy and material consumptions in the production of a 2-gram 32MB DRAM chip. I have found a US patent (number 4,110,139: *Process for preparing bands or belts, particularly suitable for use as watch bands* (Mashida *et. al.*, 1978)) which describes a manufacturing process of a watch band that could be used in our silent alarm. The semiconductor paper has given me the idea to analyse the energy and mass flows during the production of the watch band, and I will use this as an example of how the energy and mass flows of our silent alarm could be analysed.

Actual or Anticipated Outcomes

Because the US patent paper contains no numerical data that I can use in an energy and mass balance analysis, I don't expect to calculate any numerical values. However, I will be able to create some basic balance equations of the form energy_in = energy_out and mass_in = mass_out. I can then display these flows in an energy and mass flow map.

Conclusions/Recommendations/Summary

Being able to completely analyse the energy and mass flows in our silent alarm system requires that the device be at least in its prototype phase, which it is not. Until then, we can only use other research to understand how the energy and mass *may* flow in our device (during production and operation), and not actually be able to test and analyse the system. So I don't think that this topic will be particularly useful at the current point in time.

References

Cengel, Y. A. and Boles, M. A., 2011. *Thermodynamics, an Engineering Approach*, The McGraw-Hill Companies, Inc., New York; United States of America.

This is one of my textbooks from ENGN2222, Thermodynamic Energy Systems. It contains the explanations and mathematical statements of energy and mass balances that I will use in my paper under the theory section.

Energy Efficiency Opportunities section, 2010. *Energy-Mass Balance: Commercial Buildings*, Energy and Environment Division; Department of Resources, Energy and Tourism; Commonwealth of Australia. Available from: http://eeo.govspace.gov.au/files/2012/10/EMB-Commercial.pdf (Accessed 18 September 2013).

This is the website supplied on WATTLE that contains an energy and mass flow map of a commercial building. I will use this figure in my paper under the theory section to demonstrate one of the forms in which the energy and mass flows can be displayed.

Mashida, T., Matsushita, S. and Ikegami, I., 1978. *Process for preparing bands or belts, particularly suitable for use as watch bands*, United States Patent 4,110,139.

This is the US patent that I will base my energy and mass flow analysis on as an example of how the analysis could be done on our silent alarm system.

Williams, E. D., Ayres, R. U. and Heller, M., 2002. The 1.7 Kilogram Microchip: Energy and Material Use in the Production of Semiconductor Devices, *Environmental Science and Technology*, 36:5504-5510.

This is the paper that I will use to demonstrate the theory of energy and mass flows. I will also use it as a basis for my analysis on our silent alarm system, in terms of the production of the device's band (as described in the US patent document in the previous source).