Is the Future of District Heating Plastic?

Original title: LCA of Low-Temperature District Heating Network Components

Nils Olsson, January 2021

Following the development of new materials and the continuous technical progress made in the construction and energy industries, district heating as a concept finds itself on the brink of a generational shift. The largest focus is put on minimizing heat losses in the network which can be achieved by reducing the system supply and return temperatures. As a result, the new conditions allow for, among other things, the introduction of new types of district heating (DH) pipes with a carrier pipe made of polyethylene (plastic) and an overall flexible structure. Besides the potential advantages in reduced installation costs and time, the plastic DH pipes are believed to be an overall more environmentally friendly alternative to the convectional DH pipes with steel carrier pipes. However, the emphasis of the previous statement lies on the word ”believed”. This master’s thesis investigates and compares the environmental profile of both new plastic and conventional steel DH pipes using the life cycle assessment (LCA) method.

A specific case related to a new low-temperature district heating (LTDH) network at Brunnshög, Lund is used as the foundation for the comparison. The grid is owned and managed by the energy company Kraftringen. To be able to compare both options in a fair and consistent manner, a task or need that can be fulfilled by either one of the alternatives is chosen as a sort of common denominator. In the LCA domain, this task or need is dubbed *functional unit* (FU) and in this particular scenario it is decided to be a specific branch of the network, approximately 120 meters long and supplying four residential buildings with heat. By establishing the number of pipes and additional components needed to create that particular branch of the network, the life cycles of both structures are mapped out and evaluated.

The result of the assessment is divided into four distinct categories, each representing a specific environmental issue. The plastic system, referred to as PE-RT in the report, is according to the study the slightly worse alternative in three out of four categories. The major culprit is the lower thermal insulation capacity in the studied PE-RT pipes which indirectly lead to an increased output of emissions from heat generation in power plants and similar production units. Ignoring this particular feature, the conventional steel district heating pipes are the poorer alternative in every part of the life cycle and each environmental category. The production of steel is especially hefty in the perspective of global warming. All things considered, both options perform similarly well and the small difference in the result makes for reasonable plausibility that another LCA investigating the same topic would yield a set of different conclusions. However and as explained in the report, it should be emphasized that the network at Brunnshög is in actuality supplied by waste heat rather than heat from a CHP plant. This practically eliminates the impact from the heat generation, rendering the PE-RT system the more environmentally friendly option for this specific scenario.

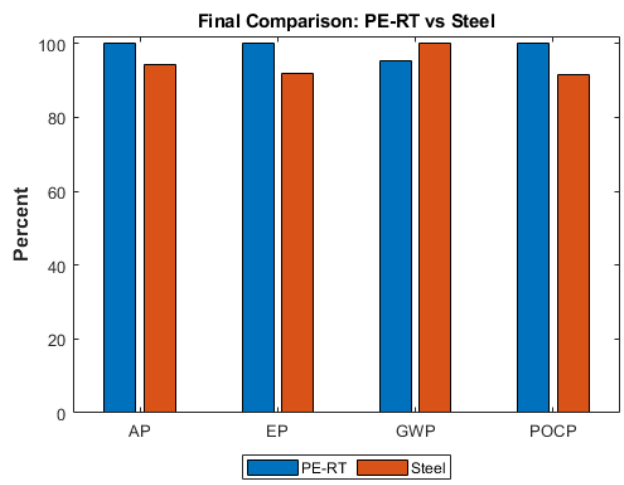

Fig. 1. Final comparison of PE-RT and steel systems. AP - *Acidification Potential*, EP - *Eutrophication Potential*, GWP - *Global Warming Potential*, POCP - *Photochemical Ozone Creation Potential*

To achieve a better understanding of the two products, the master’s thesis also looks at the changes to the results if key parameters in the respective life cycles were to be altered. Two separate studies carried out suggest that alternative production routes of steel and PE-RT could have a noteworthy impact on the final result. Different combinations of supply and ambient temperatures did have a visible but still lesser effect than expected. The largest possible change to the outcome would appear if biogenic carbon dioxide emissions from the generation of heat were to be included, a notion currently ignored for various reasons by the energy industry. Even though more a matter of fuel policies, it still affects PE-RT unproportionally in the overall comparison.

in conclusion, due to the similar environmental profile of both options, the choice of DH pipe could or maybe should be based on other factors than environmental performance. The results should not however discourage further investments into new DH technologies as improvements can and have to be made in order to reach the environmental goals set by society.

Nils Olsson