LowClyColl - Concept for significant cost and loss reduction on flat plate collectors

Alexander Stahr
Am Mühlberg 4, 09123 Chemnitz, Germany
Tel. +49 37209/69 14 87: Fax: +49 37209/50 38 55
Alexander@Stahr.engineer

In order to achieve the ambitious climate protection targets and a maximum independence from energy and raw material imports, it is essential to significantly increase the attractiveness of solar thermal energy. For this reason, the primary goal must remain to link all available technologies and industrial sectors in the best possible way. Only if we use the limited resources available to us - such as space, solar radiation intensity, capital and raw materials - intelligently and thus efficiently can these ambitious goals be achieved. The high heat transfer of flat-plate collectors is inherent to the system and requires increased effort with regard to frost protection compared to tube collectors. A concentration of approx. 50% glycol has become established, which prevents freezing of the heat transfer medium down to approximately -26°C and thus ensures protection against frost damage. The associated investment costs have so far been accepted, as has the significantly reduced efficiency compared to systems with a lower glycol content.
The aim of this concept project was to combine existing approaches to thermal frost protection for collectors using pure water as the carrier medium with the chemical principle of the glycol mixture in an advantageous way. The aim was to assess which glycol content is economically and technologically viable.

The initial installation costs, the operating costs for the auxiliary energy and the amount of solar energy re-emitted unused follow the glycol content quasi proportionally. On the other hand, the operating costs for thermal frost protection increase exponentially with increasing frost protection temperature (Fig. 1). In order to be able to determine the optimal glycol content, a collector heat model was created based on empirical values. Based on data from the German Weather Service, the probability of frost and ice days and thus the energy demand for thermal frost protection was approximated. The optimum for the assumed model system was a glycol content of 24% or an anti-freeze temperature of -10°C. This corresponds to a halving of the glycol concentration and thus of the glycol costs. At the same time, the volume flow is doubled keeping the pump capacity or auxiliary energy used constant. In the assumed model plant, this resulted in a 10% increase in overall thermal efficiency.

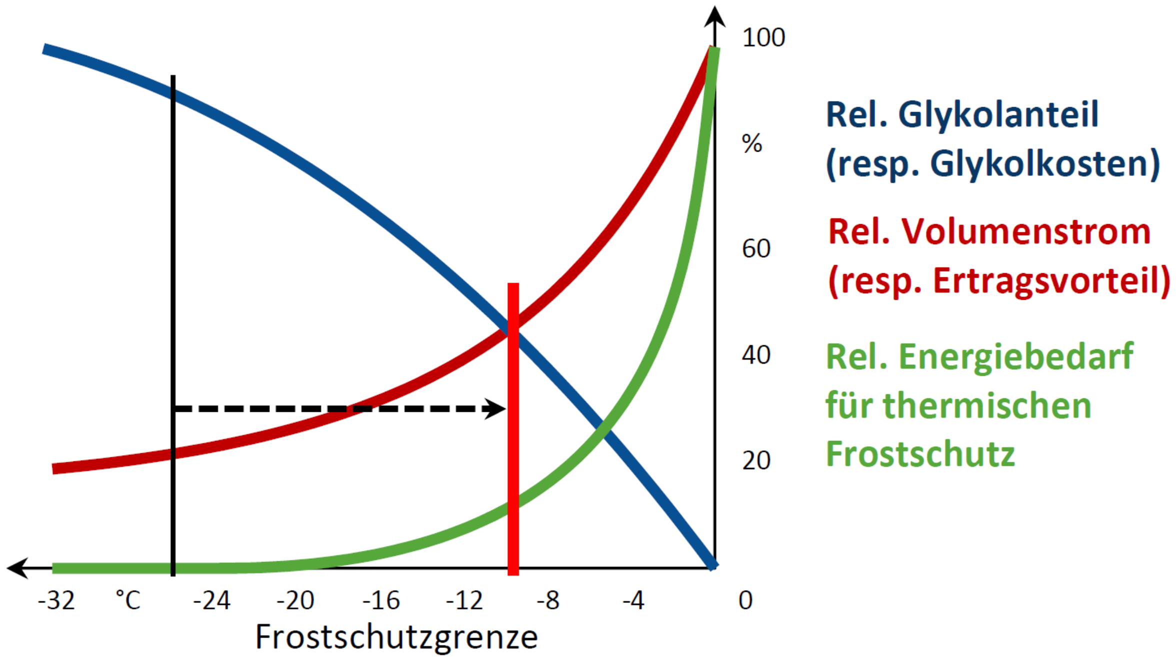

Fig. 1 - Relative parameters of chemical frost protection

In order to take full advantage of the energetic and thus economic benefits, it is necessary to apply the thermal antifreeze in accordance with the demand - i.e. close to the antifreeze limit and precisely dosed and timed. It was assumed that the real minimum collector temperature is exactly determined and suitable hydraulic devices are available. The variable hydraulics and the collector temperature model from Stahrsolar represented a suitable and available technology, since they fulfilled the necessary requirements regarding functionalities and quality criteria. The model is able to determine the lowest current collector temperature at all collector installations with an accuracy of 1K. For this purpose, it automatically adjusts its parameters for heat input and output to the prevailing exemplary conditions. The controlled heat supply takes place via a blender in the solar circuit. These technologies already meet the technical requirements of thermal frost protection reliably for water-bearing solar collectors in the long term. In summary, it was found that halving the glycol content is possible with little technical effort and can make a significant contribution to increasing the economic and ecological attractiveness of solar thermal in general and flat plate collectors in particular. The diagnostic capability of the adaptive model further increases the performance reliability and thus the attractiveness of solar thermal systems.