Ageing of plastic jacket pipe for district heat piping systems – Identification and separation of relevant influences

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The extension of district heating in combined heat and power contributes significantly to a reduction of greenhouse gas emission due to enhanced efficiency in use of primary energy. For heat transport buried plastic jacket pipes are used consisting of a steel medium pipe insulated by polyurethane foam and protected by a jacket of polyethylene. In a still running project influencing variables of ageing leading to a loss of shear strength and insulation had to be identified and characterized separately in independent experiments in order to quantify their contribution to a summarized parameter. In an experiment to separate thermic and thermo-oxidative degradation specimen were aged accelerated at a temperature of 150 °C in closed bottles and open bottles allowing unhindered diffusion into the foam, respectively. Apon implementation of density independent reduced relative values, the loss of shear strength could be determined as slope of a straight line, and the magnitude of ageing due to oxidative processes turned out to be much higher then ageing due to thermal stresses. In another series of experiments the cell gass composition was evaluated from end-sealed plastic jacket pipes and compared to a cell gas composition which would be expected from the evaluated values of gas permeation through the casing material. Whereas for nitrogen in both cases similar values were found, the amount of oxygen was much lower than the calculated amount from the permeation rate, indicating a consumption due to a reaction. Further it was shown, that cycling stresses caused by linear thermal expansion due to heating up and cooling down also contributes to the ageing process in compliance with Wöhler lines known from materials engineering. The results of the still runnung projects lead to two resolutions within the European Committee for Standardization (CEN/TC 107/WG 3) with the aim to revise the EN253.