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CHANCES FOR POLISH DISTRICT HEATING SYSTEMS

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Abstract

The most economical and rational means of heat supply for city inhabitants are district heating systems. Heat generated in power plants and large heat sources is cheaper than heat from individual sources. The reason for that is the amount of heat generated and the fuel used in district heating, a very important energy sub-sector for the Polish economy. Poland is one of the biggest users of district heating systems in Europe, and those district heating systems are mainly coal-fired.

What next with district heating systems, will they still be developing? In the perspective of a few dozen years, existing district heating systems in cities will be developing. In case when the investment in development of a district heating system is deemed unprofitable, densely built-up areas will develop local district heating networks powered from trigeneration sources, which will contribute to better comfort of living, as well as lower costs of heat supply. In the long term (50-100 years) in low-energy or passive buildings, the only source of energy will be electricity and the energy demand will be at a very low level. The article will present some problems connected with district heating systems. Energy efficiency of district heating systems depends on many things: smart grid and hydraulic analysis, heat losses from pipelines, water leakages in district heating networks. Another chance for energy efficiency is cogeneration. Thanks to its developed and centralized heat supply system, Poland is ideal for cogeneration. At present, Polish district heating systems have an extensive infrastructure of pipelines and fully automated district heating substations. Polish district heating systems have a good chance to improve energy efficiency and decrease air pollution from power and heat sources. This article shows only some problems that can give opportunities for further development of the Polish district heating systems.

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Keywords: district heating systems, district heating networks, leak detection in dh network.

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1. **Introduction**

The first water-based heating systems were created in the 19th century. In Poland, first such systems were constructed on the verge of the 19th and 20th century. These were modern systems (at the time) and their foundations are still correct. They were located in the Infant Jesus Christ Hospital in Warsaw and on the Main Campus of Warsaw University of Technology. The systems consisted of a boiler house with coal-fired steam boilers, steam engines (piston engines) powering electricity generators and a system of engine waste heat recovery. The heat was used to heat buildings and electrical energy was used to light buildings and the area around them, as well as to provide electricity for other purposes (such as Warsaw University of Technology laboratories). The system at Warsaw University of Technology was commissioned in 1901 and the heating channels built at that time are still used until today.
After the Second World War, newly erected buildings were powered by local boiler houses located in residential areas. In 1953 in Warsaw, an old power plant was transformed into a heat and power plant. In 1954, the oldest, still working electrical power plant Żerań was commissioned (it provides circa 38% of heat for Warsaw). The largest Polish heat and power plant Siekierki (the second largest plant in Europe) was constructed in 1958-1961. Since the 1960s, in Poland larger and smaller power plants have been built based on LaMont boilers (water boilers, mechanical-stoker flow-through boilers, coal-powered boilers) of the 1.5-29 MW power. (Channel) water-based heating systems were also built, with the parameters 150/80^{o}C and nominal pressures 6 and 16 bar. Internal installations were directly connected to the network with jet pumps (also often without them).

District heating substations created in the 1950s and 1960s did not have a system of usable hot water production due to the lack of appropriate controllers on the Polish market. Moreover, hydraulic regulation of the systems was very poor. Directly connected internal installations caused great network water losses and significant pollution of the water with corrosion products. In consequence, the existing networks suffered from very strong corrosion. Bad planning of city development resulted in significant oversizing of diameters of district heating networks built at the beginning of the 1990s.

Companies supplying heat to city inhabitants should provide reliability of supply in any conditions, along with low heat costs and limitation of combustion pollution emissions. In the last 20 years, there has been large progress in modernization of both heat generation systems and heat transmission and distribution systems. Efficiency of energy generation was improved, heat losses from transmission pipelines were limited. Modernization of district heating substations and installation of weather control systems also contributed to better energy efficiency of the whole district heating system. Thermomodernization processes of residential buildings conducted for circa 20 years significantly influenced the maintenance of district heating substations. The previously overloaded pipeline systems have turned out to be too large and oversized and so transmission efficiency has decreased. Further rationalization of heat production and transmission is necessary and the benefits that can be achieved are significant.[1]

How can energy efficiency of district heating systems be improved? Actions should be versatile and aimed at:

- limiting heat losses from district heating pipelines,
- limiting heat losses connected with leakages from district heating system elements,
- conducting comprehensive hydraulic analyses for pipeline systems in various maintenance conditions,
- work of a few heat sources for a joint network in an open district heating system,