Guaranteed sustainability: “The one-pump system” in building automation and control

Translated from German
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Today’s building automation and control for heating, ventilation and air-conditioning systems (HVAC) or heat transfer stations is often characterized by complex hydraulic circuits and various interacting circulating pumps, differential pressure regulators and control valves. The following article describes a radical simplification of the hydraulics. Based on gravity heating systems which do not require a circulation pump, the aim is to design a heating and cooling system in which the distribution of heat or cooling is controlled by their consumers and where the number of fittings is reduced to a minimum.

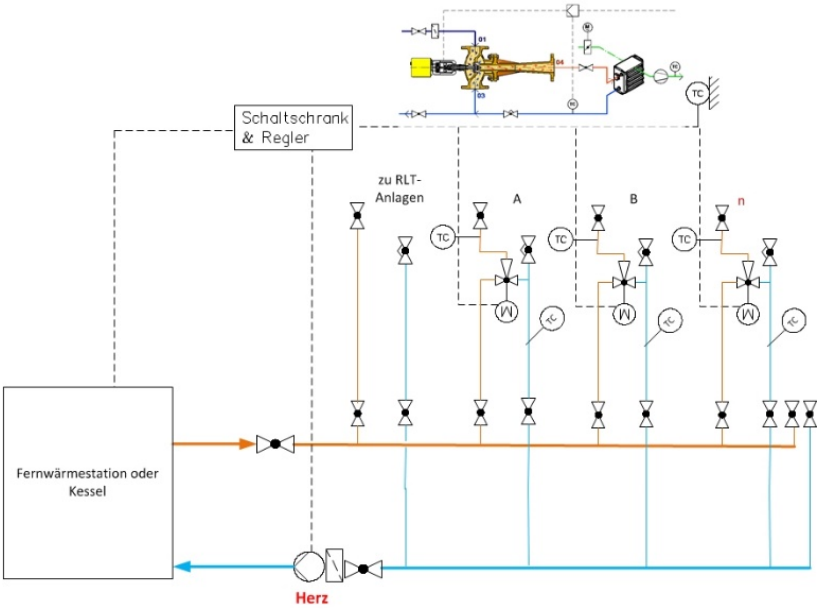

Figure 1 *System design for heat and cooling distribution at Vivantes Berlin Hellersdorf 2015*

The heat output of the various consumer circuits (heating A, B to n circuits, n ventilation systems) is controlled with ejectors and involves a simple admixture regulation using the injector effect. The differential pressure generated by the main pump in the system can be used anywhere in the property thanks to the use of ejectors for circulating the heating water with return admixture via the respective

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Tel +49 7131 1500-0 · www.baelz.de · mail@baelz.de

heating surfaces and ventilation registers. This means that no further circulating pumps are necessary in the whole of the system.

In the case of a 400 m pipeline (which corresponds to a track length around a football pitch), for example, only a 60 kPa discharge head is required with a 150 Pa/m pressure drop. How many pumps would usually be installed in a property with a considerably larger surface area than that of a football pitch? The many pumps which are commonly planned affect one another or have to be decoupled with hydraulic separators, differential pressure regulators or overflow circuits. The one-pump system renders these complex hydraulic processes unnecessary.

The more homogeneously the hydraulics of the overall system are designed, the lower the required differential pressure of the main pump. The book “Regelungs- und Steuerungstechnik in der Versorgungstechnik” [Regulation and Control Technology in Supply Systems] (Working Group of Professors for Control Technology in Supply Systems), 7th edition 2014 outlines the hydraulic circuit, performance map and control characteristics of ejectors.

The advantage of this system is not only the clear hydraulics and hence the simple hydraulic balancing but also the reduced investment costs. The ejectors are nothing more than long-life control valves. Figure 2 shows an ejector which was installed in a heating system at the Free University of Berlin in 1977 and which is still operating perfectly. Investments in control valves are therefore replaced by investments in ejectors. Dispensing with circulating pumps and the required accessories and control therefore creates a **considerable saving potential** depending on the number of control loops: As well as requiring data points for DDC and BAC, circulation pumps also need to be controlled from the switch cabinet and, additionally, make check valves in pipelines to prevent incorrect flow necessary. Furthermore, with the new simplified system all differential pressure regulators can be dispensed with.

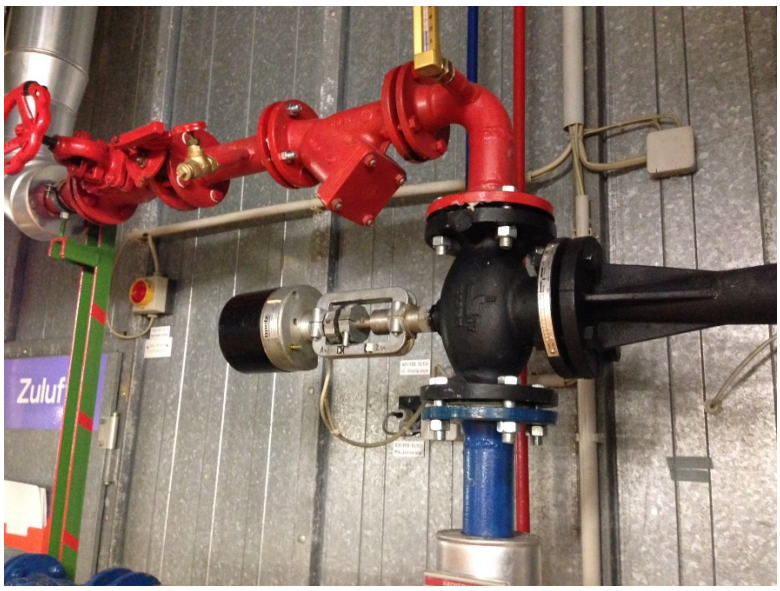

Figure 2 *Ejector installed in a building at the Free University of Berlin in 1977*

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Principle of ejector technology

Based on bionics – in this case on the human circulatory system – we design systems with one main pump. **Human blood circulation works with one heart** and overcomes approx. 100,000 km of supply routes (blood vessels: arteries = supply and veins = return) with on-the-spot support from muscle pumps. Buildings or local heating systems can be planned according to the same principle. The **one-pump system relies on a single main pump which generates differential pressure in the energy distribution system** (corresponding to the human heart) and controlled water ejectors for each consumer circuit.

The sustainability of ejector technology is proven in thousands of systems. Some properties with ejectors – some possibly known to you – are listed below.

Universities:

Free University of Berlin, Institute of Physics, year of construction 1977 (figure 2)

Martin-Luther-University Halle/Wittenberg; heating

University of Rostock new construction 2013-2014

University of Chemnitz Weinholdbau 2012

Hospitals:

University Medical Center Schleswig-Holstein, Kiel

Mainkofen Clinic /3/

Deggendorf Hospital

Mistelbach Hospital

Vivantes Berlin Hellersdorf 2015 (figure 1)

Other well-known properties:

Hotel Hilton Berlin, Mohrenstrasse since 1990

Events Arena, Tempodrom Berlin

Correctional Facility Burg, Sachsen Anhalt

Swimming Pool (Water World Braunschweig), Lower Saxony

Parish (Heilige Familie -- Catholic Church Berlin)

Federal Ministry of Education and Research

Industry:

Audi Neckarsulm

BMW Regensburg

Airbus approx. 1500 ejectors

Solar factory in Thalheim

VW Kassel/Wolfsburg

Steaming pits in the wood industry, Wismar

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Conclusion

This **cost-effective technology is advantageous for both the client and the operator of an installation**, but faces difficulties posed by sales-oriented lobbyists who are against it becoming established on the market. The planning for a hydraulic supply system should be based on a sound needs assessment. Integral planning by experts from different technical disciplines is the cornerstone of holistic planning for the best possible design with regard to the life-cycle costs of buildings. This should also include an **expert assessment** on the use of ejectors.

Advantages at a glance

Savings in assemblies

- Circulation pumps
- Control valves
- Check valves
- Differential pressure regulator
- Possibly switch cabinets

Control with ejectors guarantees a reduction in the return temperature for static heating.

/1/ *M. Gebauer "Die Leistungsregelung" in HLK 10/2013*
/2/ *M. Gebauer "Vereinfachung des hydraulischen Abgleichs" in Euroheat & Power December 2010*
/3/ *Prof. Dr. Uwe Bälz, Dr. Renate Kilpper "Heizungssanierung mit regelbaren Strahlpumpen"*

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