NEW CONCEPT FOR AHUs UPGRADE TO MEET HIGH ENERGY-EFFICIENCY REQUIREMENTS

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Beginning January 2018, the next stage of the Ecodesign Regulation 1253/2014 for AHUs comes into force. The reduction of energy data counts as one of the most important tasks in the optimisation of AHUs. This applies in particular for non-residential systems with large air volumes. Heat recovery is a highly successful and diversely applicable means for the targeted energy savings in room air and process air technology systems. The tightening of the regulation affects it significantly. While much has been invested in this market sector to even further increase the efficiency of such components, the topic of fans, which require up to 60% of the electrical demand of an AHU system, is mostly unnoticed. The intensification of the Ecodesign Regulation regarding SFP_{limit} values (limitation of the power consumption) greatly supports the idea of new development.

Today's AHUs are distinguished by maximum flexibility and are always conditioned for the functions of AHU systems. They form the core of every air technology system and ensure that functions and processes are optimally coordinated with one another.
The following basic requirements are in essence to be fulfilled:

- Lower energy consumption
- Minimisation of flow speed within the AHU
- Smooth, hygiene-friendly interior design of the AHU
- Simple access (expandable) to the installed components for cleaning purposes
- High variability and adjustment taken into account for performance as well as constructional circumstances and much more.

In cooperation with AHU producer Trubel Luft- und Klimatechnik GmbH, NOVENCO Building & Industry has conducted a comparative performance test in the TÜV Süd Test Laboratory. TÜV Süd is recognised as the world's leading company for product certifications and approval tests.
The comparative test was a demand from one of Germany's largest manufacturers of vehicles.
Both test were conducted with identical installation points, measure points, measure units, but with two different fan solutions - one of the best centrifugal fans on the market from an unspecified fan manufacturer and the ZerAx® axial flow fan from NOVENCO Building & Industry.
A framework of corresponding test series gave some very convincing results, where the ZerAx® fan was the unquestionable winner.
Essential to the high quality standard of AHUs, the association of producers Raumlufttechnische Geräte e.V. contributed with its guidelines, certification procedures and efficiency labels. They give investors, planers, users and operators a high degree of specified quality and in particular certainty with regards to energy. In the framework of the current Ecodesign Guideline the criteria for 1st January 2016 were intensified and will be further elevated beginning 1st January 2018.
The AHU unit manufacturer provides the verification that a supplied AHU fulfils the basic requirements (heat recovery system and filter) as well as the energy efficiency requirements (SFP value).
The AHU market uses largely supplier components of fabricates that provides certification of the data by a authorised certification institution like TÜV Süd in Germany.

After the 1980s, AHUs with centrifugal fans without housings, the so-called 'plug fans', customarily replaced axial fans with adjustable blade angles in large air conditioning systems and axial fans were only used sporadically. The German-speaking market adapted itself to the non-housed fans. This affected the high-performance axial fans in compact designs with ErP values (fan, FU and motor) up to over 80% as well as with air amounts up to over 300,000 m^3/h for both high and low static pressure, which had been on the market for years. This new kind of axial fan, new to the German market, especially reduced the high energy consumption of AHU systems in industrial systems in a brand new dimension throughout their lifespans. The largest part of the electric energy cost of an AHU system go to the electric power drive for the supply and exhaust fans. This explains why savings in this area is significantly more targeted than measures previously implemented, as the investments mostly can be presented cost-neutrally. It is self-evident that the upcoming high-performance fans also are certified for use, and therefore comply in full with the requirements of the producer association Raumlufttechnische Geräte e.V.

ENERGY DEMAND AND DIMENSIONS

If one considers the search for the ideal size of AHUs, for example for the production hall of an industrial company, one has to optimise two aspects originating from the air treatment functions: the energy demand as well as the dimensions of the respective AHU components for the operation of the AHUs. The dimensions to choose in this consideration are more valid and tightened design guidelines, transport, assembly on the installation site as well as the later maintenance and cleaning. The optimisation with respect to the energy demands for the operation of the AHUs takes place with the stipulation of minimising energy losses. The geometric as well as energy optimisation of the AHUs is in this way always subject to detailed consideration.

The reduction of the air speed, essential in most cases in the AHUs, is relatively simple to implement, unless the enlargement of the AHU cross-section takes up a problematic amount of space. The AHU manufacturers always face the problem of insufficient available space. The housing technology infrastructure must therefore always subordinate the requirements of architects and investors. Instead of dimensioning sufficient technical space, the technical setups are all too frequently neglected. The planner then has the simple choice to change his concept or to drastically shorten the AHUs. But how?

UNUSUAL PLACEMENT

The cooperation of the AHU manufacturer Trubel Luft- und Klimatechnik GmbH with the Danish fan manufacturer NOVENCO Building & Industry is now leading to extraordinary results in the framework of a corresponding test series. The AHU length is drastically reduced through reduced power consumption of the certified high-performance axial fans. After a long test series, this led to a diversity of variants of this high-performance axial fan, no matter whether oriented horizontally or vertically. The unusual placement of the fans on the end of the AHU, however, is significant. See figure 1.

This generally allows the use of dynamic energy for the system, if the fan is positioned on the AHU outlet and treated air is transported directly into the connected duct system that is to be supplied. In this way, the energy-optimised AHU blows air with virtually constant speed from the inlet up until the last component. Only in axial fans, without airflow diversions and with symmetrical diffusion, is the dynamic energy optimally used in the system. Customarily strong pressure drop sensible airspeed-decreasing and -increasing passages are reduced. which is of benefit to the entire pressure loss of the AHU. Unavoidable airspeed increasing at te outlet of the AHU is generated by the axial fan and deliver the total energy of the airflow to the diffuser which delivers these free of losses to the system.

Figure 1

Moreover, it is possible to implement the diffusor as a duct silencer, i.e. as an acoustic diffusor. In this way, the necessary noise-reduction on the outlet side is within reach and it is possible to remove the silencer on the pressure side and reduce the entire pressure loss.

DESIGN EXAMPLE WITH 17 ROOF AHU

The following design example, from large-scale industry with in total 17 roof AHUs, each with an air delivery of 60,000 m^3/h for a production hall, shows this clearly. In both figures, there is a recognisable supply and exhaust with a heat recovery as the circulatory network system.

Figure 2 shows to a common AHU configuration with a centrifugal fan as a free-operating wheel.

Figure 3 shows an AHU that is optimised with vertically installed high-performance axial fans and acoustic diffusors on the pressure side. The following advantages are a result of the use of the vertically installed high-performance axial fans that are presented in Figure 3 and the omission of two silencers: For series connection, the AHU is 7.7 m shorter (-33 %), 3.71 t lighter (-28 %) and has a 10.5 kW (-21 %) less electric consumption. The savings on the electric energy consumption leads to operational cost savings for the project of 10.5 kW x 6,500 h/year x 0.1 €/kWh = 6.825 € per year/AHU when the ventilation system is operated 6,500 hours per year. A brief amortisation time of approx. 10 months results from the use of this optimised AHU. For a given product lifetime of 25 years and 17 identically constructed AHUs this means savings in electric consumption of over 25 mil. kWh.

SAVINGS VALUES CONFIRMED

As part of the ISH conference in Frankfurt am Main in March 2017, the data presented in this article was published for the first time. Since these high savings options present a quantum leap in comparison to conventional AHUs, after several successful measurements in cooperation with two known large companies, a substantial testing institute was contracted to determine an absolutely neutral efficiency statement for two completely comparable AHUs from the manufacturer Trubel with different fan systems, each at 20,000 m^3/h air capacity.

The extensive measurements of TÜV Süd impressively confirm the values previously identified by Trubel Luft- und Klimatechnik GmbH. See figures 4 to 8.

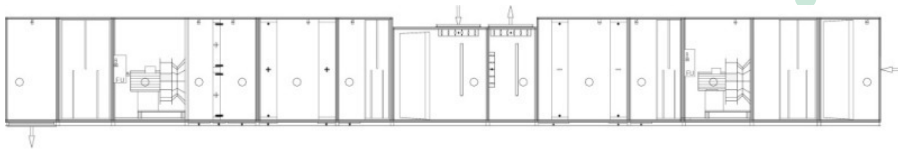

Figure 2- AHU with centifugal fans

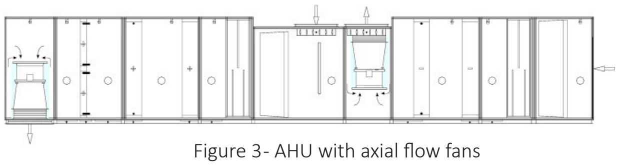

Figure 3- AHU with axial flow fans

Figure 4

CONCLUSION

Through the optimisation of every department of high-efficiency influencing variables – more energy-efficient, shorter, and lighter – and in relation to the life-cycle cost of AHU systems, the market chances of this high-efficiency AHU version increase significantly. This kind of AHU design shows in an impressive way what possibilities still exist in energy-saving.

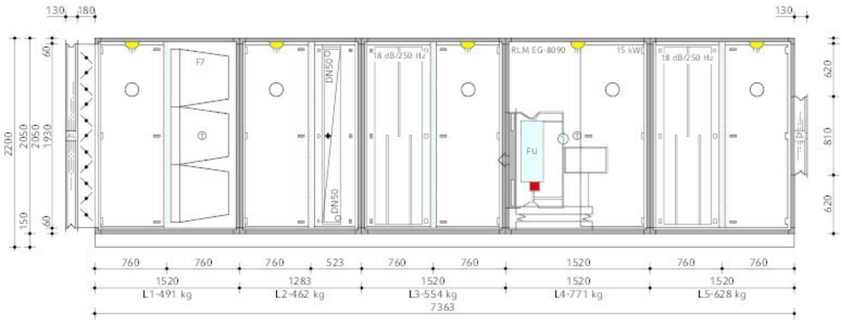

Figure 5

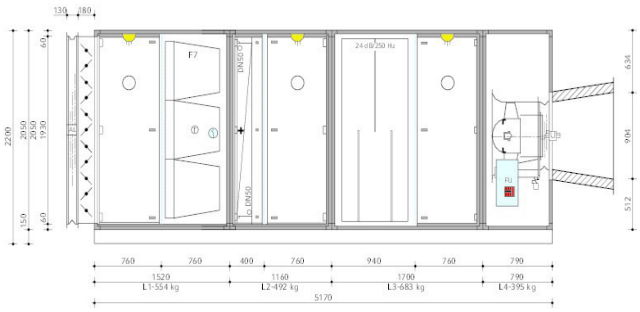

Figure 6

Figure 7

Figure 8

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