Air-Conditioning of the Laboratory for Testing of Samples for the Coronavirus Called "Fiery Eye"

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Introduction

A laboratory for testing of samples for coronavirus called "Fiere Eye" was opened at the Clinical Centre of Serbia in Belgrade on April 20 this year. The central air-conditioning system of the laboratory with extremely strict hygienic and internal parameters of temperature and relative humidity was constructed. Air handling unit that provides the said parameters is a product of the company "Soko Inžinjering" under the designation "K7-4 HG" made in accordance with the standards and recommendations that the systems for this purpose must meet. All tests of authorized validation laboratory confirmed the required parameters.

About the Laboratory

The new laboratory for testing samples for the "Fiery Eye" coronavirus is a donation from the Chinese BGI Institute. It was modeled on the best laboratory in the city of Wuhan, with which China managed to defeat this pandemic. The very name of the laboratory comes from the Chinese myth in which the "fiery eye" can see every spirit and devil.

The capacity of the laboratory is 2,000 samples per day, which is equal to the capacity of all other laboratories in Serbia where coronavirus samples are currently being tested. This lab significantly accelerated the testing of samples for Covid-19, and thus helped suppression the spread of this global pandemic. It employs 40 health workers, molecular biologists, in three shifts, seven days a week.

The second laboratory is in the city of Nis and has a capacity of 1,000 tests per day.

The laboratory is located within the Clinical Center of Serbia Figure 1. The facility is designed as a separate unit and has 750 m², of which clean rooms of class ISO8 occupy an area of 300 m², with 12 separate rooms.

Challenge they face

The company Soko Inžinjering has been present on the market since 1992, and it deals with the production of

Clinical Center of Serbia in Belgrade.

air-conditioning, heating and cooling equipment, as well as the execution of all mechanical and BMS installations.

At the time of state of emergency, when the virus pandemic reaches its peak worldwide, when everyone is facing unknown, in the phase of elaborating a technical solution due to unconfirmed technology, the task was set to produce air handling unit, air ducts, to install complete equipment in the facility and to put the entire air-conditioning and ventilation system into operation. A specific challenge was to procure appropriate elements, organize production, install in the facility and successfully put into operation, in aggravating circumstances and a short period of 15 days, in order to meet all set requirements.

Faced with the challenge, they were given security by numerous references from the field of medical institutions and hospitals, their own production, as well as the fact that they have been holding Eurovent Certificate for air handling units for 7 years and are successfully passing all tests in terms of quality (strength, sealing, thermodynamic performances, ...).

Technical task

- The laboratory air-conditioning system is a separate system with respect to other air-conditioning systems of the Clinical Centre.
- Hygienic construction in accordance with the standards and recommendations for this purpose systems.
- Application of ventilation with fresh air dilution and laminar flow at low speed, without the possibility of air recirculation.
- The adopted amount of air corresponds to a larger number of air changes, in order to prevent the deposition of particles.
- Use of high efficiency filters, ePM1, intended to stop particles up to 1 micron in size. Filtration efficiency of 50% in the first stage, then of 80% in the second stage and with absolute filters at the end, having an efficiency of 99.97% for particles with a size of 0.3 microns.
- Adequate distance is provided between exhaust air discharge point and fresh air intake with mandatory filtration of exhaust air, so as to prevent fresh air contamination.
- Controlled ventilation system preventing the penetration of the air from contaminated part to other areas, in terms of appropriate underpressure/overpressure and prevention of exfiltration / infiltration of particles.
- Achieving appropriate temperature and relative humidity parameters.

Adopted parameters and final construction

The two stage air handling unit was chosen, operating with 100% fresh air of 18,000 m³/h.

On **Figure 1** is given Mollier's Diagram showing the changes in air conditions for external design parameters in winter and summer period and **Figure 2** shows air handling unit configuration.

Heating capacity of 200 kW with hot water regime of 80/60°C from the district heating system was adopted. Cooling capacity is 175 kW with cold water regime 7/12°C from the existing chiller plant.

For the second laboratory, which was opened three months later in Nis, refrigerant R410A was used as a cooling medium, and independent cooling system with Hitachi "Utopia DX" condensing units.

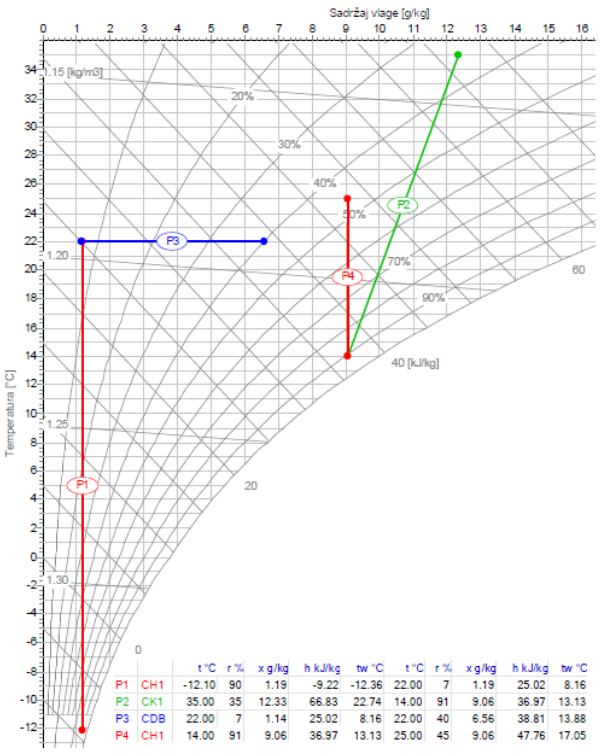

Figure 1. Mollier diagram (h,x chart).

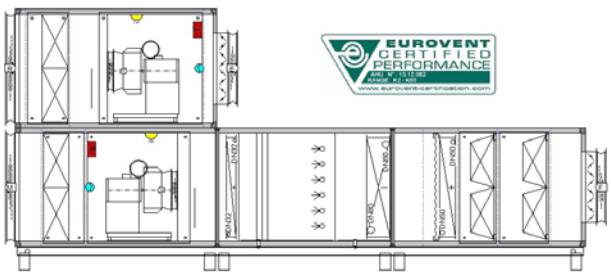

Figure 2. Air handling unit configuration.

It is planned to maintain relative humidity within the limits from 40% to 60%, because this range is least suitable for microorganisms. Class F7 and F9 fine filters were installed on delivery side. Absolute H13 filters were installed, both on delivery, and exhaust side of the air handling unit. Fans with variable rpm speed were used, in order to achieve appropriate pressure difference.

Air distribution ducts play an important role in air-conditioning and ventilation system, because they significantly affect the air quality and energy efficiency of the entire system.

Special attention was paid to very process of fabrication and proper installation of the ducts, whereby uniform air distribution, the highest class of sealing (air-tightness), hygienic adequacy and easy maintenance. **Figure 3** shows Air handling unit in the facility in installation phase.

Figure 4 shows Laboratory in equipment installation phase in city Belgrade and **Figure 5** in city Niš.

Applied standards and recommendations

- EN 1886 – Ventilation of buildings, Air handling units, Mechanical performance
- EN 13053 – Ventilation of buildings, Air handling units, Rating and performance for units, components and sections
- DIN 1946-4 – Ventilation and air handling units in health care areas
- VDI 6022 – Hygienic requirements for ventilation and Air Handling Unit systems, special
- requirements for systems used in people's occupations (air quality)
- REHVA Guidebook No.9: Hygiene Requirement for Ventilation and Air Conditioning provides guidance on hygiene requirements for planning, installation, maintenance and operation and describes appropriate test procedures and test criteria for ventilation and air-conditioning systems and airhandling units.
- REHVA COVID-19 guidance document www.rehva.eu/activities/covid-19-guidance
- ASHRAE Position Document on Infectious Aerosols

Figure 3. Air handling unit in the facility in installation phase.

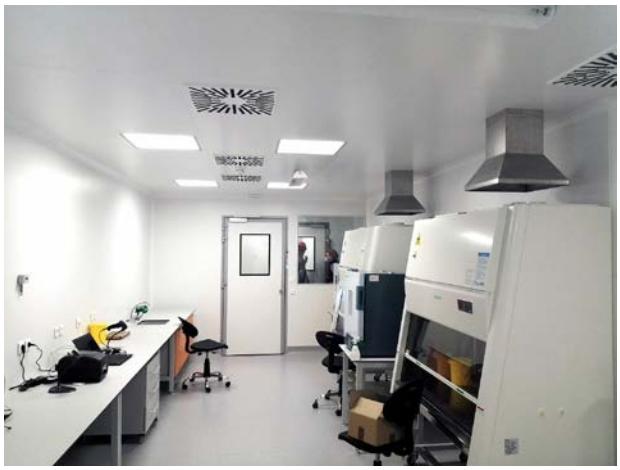

Figure 4. Laboratory in Belgrade in equipment installation phase.

Figure 5. Laboratory in Nis in equipment installation phase.

Conclusion

Nowadays, the world is facing an increasing threat from viruses and bacteria and no less threat from shortage of energy-generating products. Implementation of all safety measures on the one hand and preservation of remaining energy potentials and the finding of possible savings on the other hand are of exceptional importance. Finding the right balance will be a challenge for heating, cooling and air-conditioning profession in the forthcoming period. ■