Clean air - of course

Ionization is a process that enables the ambient air to be cleaned in a natural and, of course, sustainable manner. In order that the indoor air is rid of harmful substances and odorous emissions, ionair imitates the cleaning process of nature artificially with its Air Quality System (AQS). *Text Paolo D'Avino*

Before Google appeared and algorithms were anchored as a common term in general linguistic use, the people at LK Luftqualität AG (ionair) had already been working with them for a long time. In contrast to the functions with the search engine, however, the algorithm with the Central Swiss Company consists of simple and comprehensible operations. The formula is plain and simple: measure, record and adjust. «If you want to improve the quality of indoor air, then three factors are indispensable» explained Beda Weibel, CEO of the company, on the tour of the company in Lucerne. According to the graduate mechanical engineer ETH: «Firstly, the air quality must be measured with gas sensors and the measured data acquired must be recorded before you can intervene in the situation and respond to it». For over 20 years, the company has specialised in the improvement of indoor air quality. The process is called «air ionization». Even the founder of ionair, Werner Fleischer, proceeded in accordance with the same principles 20 years ago. This saw the development of, on the one hand, independent sensors, and on the other hand, sensors that were affordable and available for the first time on the market, in order to be able to continuously measure the harmful substances indoors. «A scientific quantum leap» explained Weibel, since the gas sensors, especially for the continuous measurement outside the laboratory, were still at an early stage of development. Consequently, in the 1990s, Fleischer had no option but to develop his own sensors for his technology.

Simulation of natural processes

«The ionization of the air is a natural process that takes place continuously in the atmosphere» outlined Weibel in his documentation for the 3rd Swiss hygiene conference. The cosmic radiation from space as well as the radiation from the uppermost layers of the Earth or certain rocks or gases such as radon, for example, is responsible for this situation. «Other sources of air ionization are water sprays such as ocean water or waterfalls, special appearances of wind and even lightning» continued Weibel. These sources of energy move electrons that are trapped from oxygen molecules in the air. In other words, it is a matter of the transmission of natural energy to the air. The more energy the air contains, the more reaction-friendly

it becomes. Artificial air ionization simulates this reaction or this natural process. The method for air treatment works with ionization tubes that ionize the air via electric discharge. «These tubes are installed either in a mono-block or in a supply air duct, where they are used after the usual air treatment such as filtering, cooling, heating, humidification or dehumidification» stated Weibel. A processor with a five-time sensor adaptation then ensures an optimal mode of action in the desired rooms. According to Weibel, this means that there is a constant balance available between oxidizable gases and oxygen ions in the ionized rooms. If irregularities or malfunctions are identified in the process that the controller cannot correct on its own, the customer and the service technician are notified and suitable measures can be initiated promptly. The gas sensor immediately triggers an alarm if the customer-specific values entered are exceeded.

Clean air for well-being

Apart from the intake of food and water, the human being needs air to live. «About 20 kilograms of air daily» stated Weibel. Good and healthy room air is not only important for health - even well-being and productivity depend on it. Clean air is apparently not something that can be taken for granted. Several studies conducted at different times and places in Europe have established that the air quality or the comfort is assessed by users as being unsatisfactory based on odours in many office buildings. Since 1983, the World Health Organisation (WHO) has been defining a series of mood disorders which, among other things, are correlated to the room air quality. One such disorder is the «Sick Building Syndrome» (SBS). «Hence, measures for cleaning the room air will increasingly gain importance in the near future» explained Weibel. In this day and age, there are a number of harmful substances in the air, which – without counter-measures such as ionization – might possibly have an unfavourable impact on well-being and health. Air conditioning systems, primarily in humid climatic zones, may be the starting point for spreading bacteria and mildew. Possible causes could also be the contamination of filters and moist locations in the air lines. Similarly, the «volatile organic compounds» (VOC) that are contained in various products such as paints, lacquers, cleaners, body care products and in spray cans as propellant could be a factor. According to the Federal Office for Environment (BAFU), these substances get circulated when the above-mentioned products are used and have a harmful effect on human beings and the environment. In order to reduce the emissions of such VOC and to bring these down to «harmless» quantities, as a consequence of the prolonged discussion on these emissions held on 12th November 1997, the Ordinance on the incentive tax on volatile organic compounds (VOCV) came into effect.

Subjective odour sensing

«The sense of smell is a complex and highly selective phenomenon» explained Weibel. Moreover, the subjectively coloured perception could lead to disturbances in well-being. In real-life situations today, human beings spend an average of over 80% of their time indoors. A significant problem with the provision of high-quality indoor air is the combination or mixture of the air with particles, micro-organisms and gases. Weibel explained the process as follows: «Odorous substances may already be perceived below the verification limit, i.e. in conditions of extreme dilution». This is where ionair's

technology is applied. The concentration of odour nuisance is measured in the outdoor air and the extract air by «electronic noses». Furthermore, the relative atmospheric humidity, the volumetric flow rate and the ozone concentration are measured in the supply air. The power controller continuously evaluates the condition of the supply air, extracted air and the outdoor air and accurately derives the optimal ionizing intensity from it. «The ionization modules thus generate oxygen ions, depending on the situation, that decompose the existing harmful and odorous substances in a targeted manner» explained Weibel. The ionization modules work with a constant AC voltage, whereby the power consumption of the individual ionization tubes is of the order of a few watts. «As a result of this, the temperature on the surface of the tubes does not rise». This provides the advantage that there cannot be devolatilization of dust particles. Before the discharge of ionized air in the rooms to be ventilated, this comes into contact with the «ozone monitoring sensor». This monitors that the health-related limit value of ozone in the supply air is never exceeded, unless the concentration of ozone in the outdoor air has already been exceeded – which may happen, especially on hot summer days. «The ozone monitoring sensor is one of the several measures implemented that makes the entire system absolutely safe» confirmed Weibel. The size of the systems depends on the volume of air that is needed for a room and on the harmful substances in the ambient air. «Installations close to an airport or a road carrying heavy traffic need optimised system designs».

Review with favourable findings

The competence centre for Typology & Planning in Architecture (CCTP) of the University of Lucerne has dealt in detail with ionized air indoors in a review. In their contribution dated January 2013, the authors pursued the issue of whether and how ionized air has an impact on the health, well-being and the performance of human beings spending time indoors. The authors came to the conclusion that – even without any option at present to be able to compile a scientific and comprehensive opinion on this subject – the consulted studies provide unambiguous indications that there are unique correlations existing between the ion content of the air and the health, well-being and physical performance. The scientists were able to prove that ionized air can contribute effectively to improved air quality, since the proportion of aerosols and organic particles in the air gets reduced with it. The authors also noted that with a balanced indoor condition, in other words, a balance of positive and negative ions, improved oxygen absorption takes place. According to the authors, the improved absorption of oxygen has a physiologically favourable impact on human beings because the metabolic processes in the human body are based on oxidation. Ultimately, the authors note that ions are not perceptible «specifically» by the senses of human beings. However, the human being can still sense an ionized room, which is comparable with how you sense the air after a thunderstorm – i.e. that the air has freshened up.

Testing in practice

The long reference list of the company based in Lucerne establishes that the air ionization technology has proven itself in practice despite gaps that need to be plugged scientifically. The airport at Zurich as well as the Hotel Park Hyatt in Shanghai and the Marina Bay Sands Casino in Singapore are just a few of

ionair's regular customers. «We already have over 6,000 such Air Quality Systems (AQS) worldwide and have installed them in the most diverse climatic zones» said CEO Weibel. Therefore, even the Inselspital in Bern is one of our customers. «Good air quality and hygiene are the measure of all things in a hospital with respect to the convalescence of a patient» emphasised Benjamin Schwarz, Department Head, HVAC systems. The requirements and demands on man and material are accordingly stringent. Schwarz and his team of 37 members monitor approximately 1,800 individual HVAC systems, which they manage 24 hours a day/7 days a week. According to Bruno Rentsch, Factory Manager for ventilation and air conditioning at the Inselspital, the requirements change for every zone in the hospital. Depending on the need, the indoor air is filtered, cooled, heated, humidified or dehumidified differently. Understandably, different climatic conditions must be met in an operation theatre than those in a common room or lounge. Despite the maintenance, management and need-based control, the workshop receives about 30 complaints per week that the Workshop Manager has to follow up on. «This forms part of the daily business» explained Rentsch, adding that the feeling of comfort is a complex issue, on which the weather and the outdoor temperatures have as much of an impact as the emotional condition of a person.

No more complaints

The comfort is the sum of a technical climate in day-to-day life. And with circa 8,000 employees and about 40,000 patients each year, at the Inselspital it cannot always be «uniformly» specified, explained Schwarz. «Too warm, too cold or too much draught: everyone finds it to be different». In addition, the background noise, the to and fro movement indoors or the existing harmful substances and odours in the air affect the state of the mind enormously. The correlation cannot always be established and proven, emphasised Schwarz, although experience shows that human beings perceive odours more intensively at high temperatures, high levels of humidity and poor ventilation. «Harmful substances can generally be tackled by feeding more air» added Rentsch. You virtually flush them out of the room, but nonetheless, this is not always possible in certain situations. A great challenge for building automation equipment is posed by the flexible construction of the building these days and the changeovers resulting from this in hospital operation, where examination and treatment units, operation theatres, as well as medical services, are located under a single roof and you cannot increase or affect the volume of air and the air speed – without prior test results – based on the standards and directives applicable. «For systems that have low air exchange rates and source flow rates, the duct network and the air volume cannot always be expanded as desired» added Schwarz. Based on such restrictions, we ultimately – upon recommendation – came into contact with the AQS of ionair. «In the meantime, the shock and operating rooms as well as the wardrobes for the personnel are ionized artificially» explained Schwarz, which led to the fact that complaints and objections – which were often raised before the ionization – could be reduced to a large extent.

Approval of the ionization system

«All providers and manufacturers in the market for ionization systems must comply with the technical standards» stated Weibel. Technical standards are reviewed in the course of laboratory tests by independent test institutes. «These certificates are just as meaningful for third parties as they demonstrably and authoritatively certify that the provider complies with all relevant technical standards» emphasised Weibel. Authorities of the Federation, Canton and Municipality are composed of the industry association SWKI, the SUVA, the University of Lucerne and ionair. «The authorities, of course, are interested in restricting the risks and excluding hazards for health and the environment, which is also covered by the interests of ionair» added Weibel. Subsequently, ionair has received the approval for the tested system with the usual conditions and requirements. For example, the indoor quality of air should not be worse than that of the outdoor air (reference air) and the sensitivity threshold for ozone of 50 ppb (99.7 $\mu g/m^3$) should not be exceeded. Weibel emphasised that these requirements are met by the products of ionair. Until the time that an approved test procedure is implemented by all authorities, it is necessary to submit measurement-related declarations of ionization systems prior to commissioning them and putting them into operation. In cooperation with the authorities and all associations involved with performing the series of measurement, ionair has made significant contributions in the course of implementing a generally valid approval process. «This confirms that Switzerland is open to new technologies» remarked Weibel. In the opinion of Weibel, who acquired the company in 2012 from Werner Fleischer, this is yet another milestone. «The effectiveness and acceptance of the ionair products can be measured primarily on the basis of satisfied customers» he explained. «We are on the right path» he added. He does not allow himself to be dissuaded from the basic principle of improving the hygiene of air both permanently and sustainably. The algorithm also remains the same as it was when the company was founded: measure, record and adjust.