# THE UNDERESTIMATED COST OF LABORATORY AIR

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**Air Exchange in the Laboratory // Some ten olympic swimming pools full of air must be pumped through a laboratory of size 120m² - every eight hours. This ensures for the safety of the personnel, but it is expensive and is detrimental to the environment. However, if even small measures are undertaken, this can serve to save greatly on the costs involved in air exchange.**

*Special sealed caps provide for a hermetic sealing of solvent bottles. Air exchange in the laboratory can thereby be easily reduced, so leading to cost savings.*

Everyday work with cancer-causing or toxic materials is unavoidable in many laboratories. There exists a corresponding danger that the workers involved can become sick as a result of respiratory illnesses they might contract. An important protective measure is therefore an efficient exchange of air in the laboratory. The German Federal Institute for Occupational Safety and Medicine (BAUA) demands fundamentally that for every square metre of floor space, 25 cubic metres of air are exchanged every hour. As a result, laboratories in Germany must be equipped with correspondingly large ventilation systems. Because a human being only breathes in around half a cubic metre of air per hour, a high dilution, and therefore a correspondingly high degree of safety, is thereby provided for, even when toxic materials are being released into it. If it is possible to prove that there is no resulting increase in risk, the BAUA will also allow for a reduced - or even just a natural - level of air ventilation. This brings short-term benefits and saves thousands of Euros.

### Eightfold Exchange Standard

Conventionally, the rate of air exchange is used as a measure for gauging and evaluating air exchange. It compares the amount of air entering or leaving a room (over an hour) with the volume of air space physically located there. The Air Exchange Rate (AER) is then the resulting given ratio. An AER of 8 therefore means that all the air in a room is fully exchanged some 8 times, during the space of one hour. Exactly how much air per hour and square metre that represents, is dependent upon the ceiling height of the room. If a room has a ceiling height of 3 metres - as is the case in many laboratories - it results, approximately, in an air exchange of 25m³/m²h, as demanded by the BAUA. Therefore, an AER of 8 (more exactly, 8.33) is often used as the general yardstick for laboratories. To clarify further: if the ceiling height is only 2 metres, the total spatial room volume of air would have to be exchanged some 12.5 times per hour, in order to achieve the required 25m³/m²h.

### What does Laboratory Air cost?

Usually, there is of course a basic wish to keep the amount of air exchanged as low

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as possible, without correspondingly endangering the health of personnel. This, because the annual costs of exchanging all the air in a laboratory are quite considerable, as the following example involving a laboratory with a floor space of 120m², that is running around the clock, shows:

- **Air Exchange Rate (AER): 25m³/m²h**
- **Laboratory Area: 120m²**
- **Daily Time for Air Exchange: 24h**
- **Annual Time for Air Exchange: 365d**

If these 4 parameters are multiplied by each other, the result is a total overall air exchange volume of 26,280,000 m³/year. If an average air cost of 2 Euros per 1,000m³ and year is assumed, it results in a total overall annual cost involved of 52,560 Euros - an amount which surely offers some good potential for savings!

**Table 1: Cost Calculation for a Laboratory with 120m² and 15 HPLC Units**

| Costs for Initial Equipping | Running Costs |
|---|---|
| Price/set, comprising:<br>• 4x SafetyCaps (Extraction)<br>• 4x air valves<br>• 1x WasteCap (Disposal)<br>• 1x exhaust filter<br>• 4x laboratory bottles<br>• 1x waste disposal collecting canister | half-yearly exchange of<br>(a) exhaust filter &<br>(b) air valves |
| 15 x 500 € | (a) 15 x 1 x 75 €<br>(b) 15 x 4 x 20 € |
| Resultant Total Cost: € 7,500 | Reslutant Total Cost: € 2,325 |
| **Overall Total Investment Costs in the First Year: € 9,825** | |

### Safe Reduced Air Exchange

But what possibilities are there to reduce the AER, yet at the same time fulfilling the technical obligations for hazardous substances, as described in TRGS 526 and as demanded by the BAUA?

As mentioned before, the TRGS allows - as described under Para. 6.2.5. - for a reduction of the AER, using various methods, provided the subsequent obligatory assessment of the hazards involved still allows for „the method used to be permanently and sufficiently sustainable and effective." An effective method for reducing the AER is, for instance, to use hermetically sealed caps on laboratory supply bottles. Similarly effective is the use of exhaust filters on canisters at the waste collection side. By means of such simple methods, it is actually easily possible - in conjunction with an assessment of resulting safety - to reduce the AER from a factor of 8 to one of just 5, corresponding to a reduction of 38%. Taking the a.m. annual total overall costs of 52,560 Euros, this corresponds to a savings potential of some 20,000 Euros - for air exchange, there then remain substantially reduced costs of only 32,587 Euros p.a. This cost saving is of course not equivalent to the final direct cost saving involved, as the laboratory must first be equipped with the corresponding hermetically sealed caps. As an example, a laboratory with 15 HPLC units must first undertake a corresponding investment of about 10,000 Euros in the first year (see Table 1). During the following years, there will be further annual costs of some 4,650 Euros, for the required six-monthly exchange of exhaust filters and air valves. Summing everything up, however, these additional „hardware-related" operating costs will be very much more than compensated for by thereby achieving lower and more cost-effective rates of air exchange. Overall, the annual resultant savings enjoyed every year, as of the second year, are no less than around 15,000 Euros (see Table 2). This calculation example proves that by implementing such simple measures, every laboratory can save significantly, namely some 15,000 Euros p.a. - and without having to compromise in any way on safety!

**Table 2: Example of Amortization with an AER of 5 (basic costs: € 32,587 p.a.), as compared to an AER of 8 (basic costs: € 52,560 p.a.)**

| Point in Time | Cost of Initial Equipping | Cost of Consumables | Total Costs incl. Basic Costs, with an Air Exchange Rate of 5 | Overall Summed Savings Potential since Purchase |
|---|---|---|---|---|
| Year of Purchase | 7,500 € | 2,325 €* | 42,712 € | **10,148 €** |
| 1st Year after Purchase | - | 4,650 €** | 42,712 € | **25,471 €** |
| 2nd Year after Purchase | - | 4,650 €** | 42,712 € | **40,794 €** |
| 3rd Year after Purchase | - | 4,650 €** | 42,712 € | **56,117 €** |

* = 1x exchange of exhaust filter & air valve necessary
** = 2x exchange of exhaust filter & air valve necessary