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Energy conservation in the laboratory – Economy, ecology and occupational safety and health

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Energy conservation is currently a highly relevant topic, also in the laboratory. However, the goals pursued from an economic and ecological standpoint and with respect to occupational safety and health may differ greatly.

Therefore, all three aspects must be carefully considered when establishing energy conservation measures for the laboratory. Everyone involved bears responsibility, also for the safety and health of all persons in the laboratory.

Energy conservation measures are to be established by carrying out a prospective risk assessment in cooperation with workers. If changes arise during operations, the risk assessment must be adapted and the effectiveness of the measures monitored.

1 Procedure

Most of the energy consumed in laboratories is used for technical supply and exhaust ventilation. These systems require large amounts of energy; however, in most cases, these are also the most important measures taken to protect against exposure to hazardous substances, biological agents and excessive temperatures as well as against fire and explosions in the laboratory.

Risk assessments leave a great deal of leeway for the implementation of measures. The current state of technical knowledge is described in this article and in the DGUV Information 213-851 “Working Safely in Laboratories” of the German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung) [1] and the Technical Rules for Hazardous Substances (TRGS) 526 “Laboratorien” (“Laboratories”) of the Federal Ministry of Labour and Social Affairs (BMAS) [2].

1.1 Individual risk assessment for the laboratory

An individual risk assessment must always be prepared for the laboratory that takes into consideration the people working in the laboratory, the organisation, the work activities as well as the properties and amounts of the substances being handled. The preparation of the risk assessment must involve the equipment operators, laboratory supervisors, the people working in the laboratory as well as occupational safety and health experts to ensure that all prevailing conditions are assessed and suitable measures are established.

1.2 Adjustment of the time management of technical supply and exhaust ventilation

The adjustment of the time management of technical supply and exhaust ventilation in laboratory units is one option that may be considered. However, the persons working in the laboratory must always be informed in which operating mode the ventilation system of the laboratory is running at any given time (for example, night and day settings, reduced operations) and must be able to recognise the setting (for example, via traffic light systems, visible or audible signals in the laboratory). This includes, among others, controlling the level of ventilation according to a time schedule for specific periods of use and technical options for starting the ventilation system if it is in a reduced mode of operation (occupancy button, central control panel in the laboratory). It is not always possible to individually lower the level of ventilation for each laboratory unit in a building. In some cases, it is possible to regulate only the entire building or a specific ventilation duct. The system must respond to adjustments of the settings at a sufficient rate.

1.3 Communications structure

A suitable communications structure must be established to ensure that all persons involved are informed of any changes made and implement the requisite measures correctly.

1.4 Activities carried out outside of the fume hood

For all activities carried out outside of the fume hood, the amount of substance that may potentially be released must be determined as well as the hazard this may pose for workers/insured persons.

1.5 Compliance with occupational exposure limits

Additionally, the laboratory owner must be able to document compliance with occupational exposure limits and other assessment criteria in the laboratory even after the air change rate has been reduced. For substances without occupational exposure limits, the owner must establish whether the implemented technical protective measures are sufficiently effective. This is documented by means of workplace monitoring or other suitable methods for determining exposure levels.

1.6 Cases with a minimum level of exhaust ventilation of 25 m³/(m²*h)

As a rule, it is not recommended to reduce the exhaust ventilation or the number of air changes to a level below 25 m³/(m²*h) during working hours:

- if changes are expected to be made at short notice, for example with respect to the substances or work procedures used (such as in research and development laboratories),
- if non-professionals are working in the laboratory, such as students, or
- if activities are expected to be carried out also outside of the fume hood for organisational reasons, such as during hands-on training.

1.7 Acid/lye storage cabinets

It is not recommended to reduce the extraction of exhaust air from acid/lye storage cabinets or generally to turn off the exhaust outside of working hours because a corrosive atmosphere will develop that may cause permanent damage to the cabinets.

1.8 Safety cabinets for toxic gases

According to DIN EN 14470-2 [3], safety cabinets for the storage/supply of pressurised gas cylinders containing toxic gases must have a constant air change rate of 120 per hour. The air change rate must not be reduced, even outside of working hours.

1.9 Safety cabinets for other pressurised gas cylinders

The risk assessment must assess whether the exhaust ventilation of safety cabinets for pressurised gas cylinders may be turned down or off. The location of the safety cabinet must also be taken into consideration. If safety cabinets are located in corridors, their ventilation system must not be turned down.

1.10 Safety cabinets for flammable solvents

The risk assessment must assess whether the exhaust ventilation of safety cabinets for flammable solvents according to DIN EN 14470-1 [4] may be turned down or off. This must be assessed also with respect to explosion safety.

1.11 Insufficient extraction of heat

The following problems may arise if insufficient amounts of heat are extracted because of reduced ventilation, thereby increasing the temperature of the work area:

- Inability to concentrate, which may increase the risk of accidents or adversely affect the work quality (for example, higher error rate). This clearly goes beyond the requirements for a comfortable work environment.
- If insufficient amounts of heat are extracted, this may lead to dangerous equipment malfunctions.
- The vapour pressure of all substances increases with the temperature. This may lead to increased concentrations in the respirable air and pose a hazard to health as well as fire and explosion hazards.

1.12 Lighting

Energy conservation measures may include the lighting only if continuing compliance with the minimum lighting requirements according to the Technical Rules for work places ASR A3.4 [5] and DIN EN 12464-1 [6] is ensured, for example by installing LED lighting. Insufficient lighting may lead to deficiencies in visual perception (for example, errors when reading measured values, the inability to recognise defects).

2 Further information about the possibilities and limitations of energy conservation in laboratory ventilation

Extensive efforts are currently underway to conserve energy in the laboratory. Most of the energy consumed in laboratories is used for the supply and removal of air and the heating of incoming air. However, collective ventilation and working in fume hoods are the most important protective measures for handling hazardous substances in the laboratory. Therefore, the subcommittee “Laboratory” has

concluded that it is not possible to make general recommendations for reducing the use of supply and exhaust ventilation while still ensuring the safety and health of workers and insured persons.

The provisions of the Hazardous Substances Ordinance (GefStoffV) are specified by the protective measures developed for activities with hazardous substances in laboratories by the Technical Rules, in particular TRGS 526 “Laboratorien” (“Laboratories”) [2].

If these protective measures are implemented by the laboratory owner, it can be assumed that the workers/insured persons do not have inadmissibly high levels of exposure and the hazard is kept to a minimum. In this case, the requirements of the Hazardous Substances Ordinance have been fulfilled.

However, if these measures are not complied with, laboratory owners must be able to document that the same level of safety is achieved by other means.

For example, fewer air changes or natural ventilation may be used if the risk assessment concludes that these measures are sufficient and effective for the intended activities in the long term. If the exhaust ventilation is reduced (thereby reducing the supply of fresh air), the laboratory owner who is responsible for this area must implement protective measures that minimise the hazards posed by hazardous substances for the persons working in the laboratory to the same level as would occur with the standard air change rate of 25 $m^3/(m^2*h)$.

The volumetric flow rate of exhaust air per unit area of 25 $m^3/(m^2*h)$ may be reduced if the risk assessment carried out according to TRGS 400 “Risk assessment for activities involving hazardous substances” [7] concludes that the protective measures taken are sufficient for the intended activities.

2.1 Article 7 of the Hazardous Substances Ordinance (GefStoffV)

(4) The employer is to rule out any hazards to the safety and health of workers carrying out activities involving hazardous substances. If this is not possible, the employer is obligated to reduce these to the minimum necessary. The employer must comply with these provisions by identifying and implementing suitable protective measures.

In doing so, the employer is to observe the following order of precedence:

1. ...

2. the use of technical collective protection systems at the hazard source, such as adequate aeration and exhaust ventilation, and the implementation of suitable organisational measures,

3. ...

…

(8) The employer is obligated to ensure that occupational exposure limits are observed. The employer shall ensure that the limits are not exceeded by monitoring them at the workplace or applying other suitable methods to determine exposure levels. Determinations are to be taken also if conditions change that may affect the exposure of workers. The results of the determinations must be documented, stored and made available to workers and their representatives. If activities are carried

out according to a criterion for a specific procedure or substance that was published in accordance with Article 20 paragraph 4, the employer may in general assume that the occupational exposure limits have been observed; in this case, sentence 2 shall not apply.

(9) If activities are carried out involving hazardous substances for which an occupational exposure limit has not been established, the employer must regularly monitor the effectiveness of the technical safety measures taken using suitable methods of assessment, which may include determinations at the workplace. [8]

2.2 TRGS 400 No. 6 (4)

If a TRGS is available for a specific substance or activity or a TRGS has established VSK (process-specific and substance-specific criteria), the employer may directly apply the measures recommended by the relevant TRGS or VSK if these describe the activities and hazards under assessment. In this case, employers may assume compliance with the Hazardous Substances Ordinance for the described activities if they implement the measures established in these guidelines. If deviations from the recommendations of a TRGS are made, these must be justified and documented in the risk assessment. The planned measures must ensure the safety and protection of the workers in a commensurate manner [7].

2.3 TRGS 526 Section 6.2.5.1

Laboratories must be equipped with technical systems that ensure adequate ventilation at all times. If necessary, it must be possible to heat the supply air and introduce it into the room without creating a draught. The exhaust air may be completely or partially extracted via fume hoods provided they are still able to operate at full capacity. An air change rate lower than 25 m3/hour per square metre of laboratory floor area or natural ventilation may be used if the risk assessment concludes that these measures are adequate and effective in the long term for the activities being performed. If a laboratory is operated at an air change rate lower than the requisite 25 m3/hour per square metre, certain activities, for example those involving flammable liquids or other hazardous substances that are highly volatile or generate dust or aerosols, must be kept to an absolute minimum unless other additional protective measures are taken. Any such restrictions of use for the laboratory must be documented and the laboratory owner must inform all persons in positions of responsibility, including those who subsequently assume such positions. Signs must be posted at the entrance to laboratories operating during working hours at an air change rate that is lower than the required level with the wording: “Warning: Reduced ventilation!”. In individual cases, the risk assessment may stipulate a higher air change rate [2].

2.4 TRGS 526 Section 4.11.1

Activities that lead to the development of gases, vapours or aerosols in hazardous concentrations or amounts may be carried out only in fume hoods. The sash must be kept closed during these types of activities.

Activities that lead to the development of gases, vapours or aerosols in hazardous concentrations or amounts may only be carried out outside of a fume hood if suitable measures have been taken or it is possible to rule out that these substances pose a hazard to the insured persons by virtue of the type of work being done [2].

Bibliography

[1] DGUV Information 213-851 “Working Safely in Laboratories”, source: medienshop.bgrci.de..

[2] TRGS 526 „Laboratorien", Ausgabe: Februar 2008, Quelle: www.baua.de.

[3] DIN EN 14470-2:2006-11 „Feuerwiderstandsfähige Lagerschränke - Teil 2: Sicherheitsschränke für Druckgasflaschen", Quelle: www.beuth.de.

[4] DIN EN 14470-1:2004-7 „Feuerwiderstandsfähige Lagerschränke - Teil 1: Sicherheitsschränke für brennbare Flüssigkeiten", Quelle: www.beuth.de.

[5] ASR A3.4 „Beleuchtung", Ausgabe: April 2011, Quelle: www.baua.de.

[6] DIN EN 12464-1:2021-11 „Licht und Beleuchtung - Beleuchtung von Arbeitsstätten - Teil 1: Arbeitsstätten in Innenräumen", Quelle: www.beuth.de.

[7] TRGS 400 „Gefährdungsbeurteilung für Tätigkeiten mit Gefahrstoffen", Ausgabe: Juli 2017, Quelle: www.baua.de.

[8] Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung - GefStoffV) zuletzt geändert durch Artikel 2 der Verordnung vom 21. Juli 2021 (BGBl. I S. 3115), Quelle: www.gesetze-im-internet.de.

Publisher

German Social Accident Insurance

Deutsche Gesetzliche
Unfallversicherung e.V. (DGUV)

Glinkastraße 40
10117 Berlin, Germany
Phone: +49 30 13001-0 (switchboard)
Fax: +49 30 13001-9876
Email: info@dguv.de
Internet: www.dguv.de

Subcommittee “laboratories”
Expert Committee “raw materials and chemical industry”
of the DGUV www.dguv.de Webcode: d138225