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The art of handling air

TEN STEPS TO TACKLE ENERGY CONSUMPTION IN LABORATORIES

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Reducing energy consumption in UK buildings has gained a new sense of urgency over the last year. With so much uncertainty regarding pricing of gas and electricity, building owners and occupiers are looking to estate management teams, and their HVAC technical specialists, to help them regain a degree of control over this aspect of operating cost.

For buildings incorporating laboratories, the implications are particularly serious. The energy consumption of laboratories is often more than three or four times that of offices on a square metre basis.[1]

Research has revealed that laboratory buildings are responsible for between 50% and 80% of the total energy-related (non-residential) carbon emissions of research-intensive universities. The same can be true for a wide range of other sites, including private sector laboratories, Government research facilities and hospitals, where uncertainty regarding energy pricing is creating new financial imperatives.

In comparison to mainstream office spaces, tackling energy consumption in laboratory spaces involves a number of additional technical considerations. The most obvious is the health and safety of building occupants. Any attempt to reduce energy consumption must be achieved without compromising safety through inadequate air management. Furthermore, the repeatability of environmental conditions can be crucial for the integrity of the research and testing carried out in the laboratory spaces. There are a number of ways, however, of tackling the rising operating costs of these spaces whilst maintaining all of the necessary safeguards. This article suggests practical energy efficiency solutions that HVAC specialists can implement in collaboration with estate management teams.

Step 1: Focus on fume cupboards

The key to reducing energy costs lies in efficient air supply and extraction in relation to the fume cupboards installed in the laboratories. A 900mm wide fume cupboard with a maximum sash height of 500mm and face velocity of 0.5 m/s would extract approximately 225 l/s of conditioned air from the room. This higher than average demand for conditioned air has a significant knock-on effect across the site, driving up the energy consumption of air conditioning system components such as Air Handling Units, chillers and fans.

Step 2: Ensure VAV operation

A variable air volume (VAV) fume cupboard reduces extraction automatically when the sash is closed. For the example above, this figure drops from 225 l/s to just 55 l/s when the sash is down, reducing the conditioned air requirement by 170 l/s. So transitioning older fume cupboards from constant to variable air volume has significant energy saving potential.

Step 3: Room air management

The most significant energy reductions can be achieved by integrating fume cupboard air supply and extraction with the wider air management systems to prevent wastage. Installing a room air management system (such as the TROX EASYLAB system) makes it possible for all input and extract air for the laboratory to be controlled automatically to ensure that the required ventilation strategy and levels of safety are maintained. Supply and extraction of the fume cupboards (or other technical air management devices) is automatically balanced and offset in line with changing requirements, reducing the total supply and extract volumes. For example, if the fume cupboards are open and extracting air, there is not the same requirement for the room system to carry out this process. By scaling down room exhaust air extraction in line with fume cupboard extraction, the room air management system is able to prevent wastage associated with over-supply of conditioned air, improving energy efficiency significantly (see Figures 1 and 2).

Figure 1

Figure 2

Step 4: Optimising or retrofitting fume cupboard controls

If installing a room air management system is not possible due to budgetary constraints, or if alternative energy-saving solutions are required whilst capital expenditure is in the process of being secured, there are alternative actions that can be taken to reduce energy consumption. The hardware of the fume cupboard has a comparatively long life. Controls technology, on the other hand, has advanced rapidly in recent years. As part of your audit of fume cupboard demand, it could be useful to contact the manufacturer of the equipment to discuss opportunities to improve efficiency by enhancing control of the existing hardware. It is quite common for fume cupboards to have control capability already resident but not currently configured for operation. Existing features could be brought into operation, or more advanced control could be retrofitted to the existing lab 'hardware' to maximise return on capital investment whilst providing new energy efficiency and safety capabilities.

Step 5: Automatic closing of sashes

Minor changes to day-to-day operation of fume cupboards could unlock further energy savings. Sashes are often left open when individuals are away from the fume cupboards, resulting in unnecessary consumption of conditioned air. It is a relatively simple operation to install technology to close sashes automatically to conserve energy. A PIR (passive infrared) sensor can identify that no-one is present at the fume cupboard. After a set time a visual or audible alarm is triggered to indicate that the sash have been left up. An auto sash closer can then work in conjunction with the sensor to close the sash automatically, preventing unnecessary extraction of conditioned air.

Step 6: Local heat extraction

Another way to reduce demand on the site-wide cooling and ventilation system is to install equipment such as ventilated down flow tables, canopy hoods or fume exhaust 'snorkels'. These can reduce energy consumption by taking away heat at source, and are particularly helpful where cooling demand relates to intensive usage of IT equipment on laboratory benches.

Step 7: Site-wide energy efficiency

In addition to measures taken within the laboratory spaces themselves, there are a number of best practice approaches involving operation of the centralised air management system that HVAC specialists should consider. The most significant of these involves harnessing the opportunity presented by the latest generation of VAV technology to control fan speed using positioning of the damper blade (rather than via duct pressure measurement). Installations employing this approach to date indicate that fan energy consumption can be reduced by around 45%. A number of standard TROX products and solutions have the digital control capability for this approach already resident, facilitating fan speed optimisation without the need for bespoke BMS programming. Examples include TROX's X-CUBE air handling unit, and TROX's X-AIRCONTROL system. For further information please contact us.

Step 8: Refine zone control

As part of any project to address laboratory energy consumption, review the settings of different zones to check that the air change rates suit the activities carried out in each space.

Step 9: Out-of-hours air management

It may be possible to set the BMS (Building Management System) to reduce air change rates overnight or at the weekend when the laboratories are unoccupied. Local overrides can be used to ensure that, if personnel should be working out of usual work hours, the air changes can be re-established at times when the BMS has put the building into reduced mode.

Step 10: Optimise occupancy

For new build laboratories, or for longer-term reductions in energy consumption, explore ways in which room air management systems can reduce overheads by giving laboratory facilities greater operational flexibility. Effective air management can enable multiple scientific disciplines to work side-by-side, reducing expensive under-occupation of the facilities.

For further information on improving the environmental performance of university science campuses, government research facilities, hospitals or private sector laboratories contact TROX on tel: 01842 754545 or email: sales@troxuk.co.uk

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[1]
Peter James and Lisa Hopkinson, 'Carbon, Energy and Environmental Issues Affecting Laboratories in Higher Education - A Supplement to the HEEPI Report on General Regulations and Schemes on the Topic', August 2011.

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About TROX Group

TROX is a global leader in the development, production and sale of components, units and systems for the ventilation and air conditioning of rooms. With 34 subsidiary companies in 29 countries on five continents, 20 production facilities, and importers and representatives, TROX is present in over 70 countries. Currently, the TROX GROUP has around 4,600 employees worldwide and generates revenues of around EUR 600 million.

About TROX UK

TROX UK was established in 1962 in London, UK, as the first international subsidiary of TROX GmbH, and since 1971 has been based at its manufacturing facility and offices in Caxton Way, Thetford, Norfolk, currently with approx. 150 employees. TROX UK is a manufacturer of air conditioning, ventilation and fire safety products and has the most efficient and flexible range of air distribution systems in the UK market. Working closely with architects, developers and consultants, TROX UK has supplied its products and services to many of the UK's most prestigious buildings and commercial developments.