Hans Georg Müller, Dr. Ing.-Chem. ETH
Chairman of MAX MÜLLER AG,
Process illumination and visual observation systems

How to illuminate optimally your equipment ?

A selection of evaluation criteria for sightglass light fittings and for fibre optic lightpipe light fittings

Despite of progressive automation of chemical and physical processes it is unanimously recognised that the eye of a skilled employee cannot be replaced by any instrumentation or control system, how sophisticated in itself this may be.
Proper lighting is therefore extremely important for optical monitoring of equipment.
The following article attempts to simplify the choice and placing of a suitable sightglass light fitting with the aid of a number of possibly relevant criteria. The criteria applicable to all lightfittings are considered first. The criteria for fibre optic lightpipe light fittings follow. The final part is devoted to criteria for light fittings for use in hazardous areas.

One or two port mounting?

The first criterion regards the fundamental positioning of the light: Shall be worked with a so called one port or a two port mounting? The first version offers “view and light” through the same sightglass. The second version separates the functions “lighting out” and “viewing” and necessitates therefore two different sightglasses. The strongest argument for the one port mounting is the cost factor: Obviously, two separate

Fig.1 EdelLUX® light fitting type EdelEx, completely in stainless steel, 20 W, 24 V, Ex d IIC T4 Gb, Ex t IIIC T130°C Db IP67, mounted on a VETROLUX® sightglass to DIN 28120

sightglasses are more expensive than one. Besides the cost of the sightglass itself one can omit the welding of a second base flange and the necessary preliminary preparation of the section to be cut off the vessel wall. Small containers or laboratory equipment with their little space for sightglasses may lead automatically to the one port solution, yet the disadvantages against the classical two port mounting are evident: The insight into the vessel is surely restricted since the light fitting covers always a considerable part of the insight surface. Undesired dazzle effects may occur which may even not be eliminated entirely by means of so called “anti dazzle shields” as optional equipment for the lights.
In case of the mounting of a hinged sightglass for use as a manway or for sampling or filling purposes, the light source should be mounted separately since the rough shocks occurring when closing the sightglass do considerably reduce the lifetime of the bulbs and lead to short and cost intensive service intervals.

The right supply voltage

The choice of the supply voltage represents the second principal decision. Even in cases where the voltage is given (e.g. by an already installed low voltage network for lighting purposes or by special voltages due to the respective company‘s electrical history), the choice of one of the today’s most spread voltages (230 or 24 V AC) implicates certain consequences: Light fittings with direct 24 V or 230 V supply of the bulbs are more sensitive to network tension peaks than ones with built-in transformers, whose design attenuates tension peaks and does therefore prolong the bulb lifetime. With wattages of 50 or 100 W, considerable supply cable sections have to be installed with 24 V supply. This is, in case of long distances between the supply source and the light fitting, an important cost factor. The respective sections produce additionally a not negligible tension decrease which has to be thoroughly calculated by the user prior to the light installation in order to avoid unpleasant surprises as to the expected illumination intensity.

Which fixation is the most suitable?

There are various fixation possibilities, well adapted to the respective applications. All of them do belong to 2 principally different categories: Rigid or flexible connection between light fitting and sightglass. The rigid mode is more likely for applications with little bulb changes or outside cleaning of the sightglass surface, thus with cases of long servicing intervals. These are normally the rule with no or only little vibrations of the apparatus, constant supply voltage, clean operation (e.g. no dirt on the outer sightglass surface). To the rigid fixation category belong mounting feet or flanges, brackets or intermediate flange collars for the application on sightglasses similar to DIN 11851 only. A flexible fixation via a tilting hinge or via swivelling feet is preferred in cases where the inside of the vessel has to be illuminated at different sectors depending e.g. of the filling level or of the reaction steps or if the apparatus surroundings do cause a regular cleaning of the outside sightglass surface or if frequent bulb changes are necessary due to unfavourable operating conditions. In these cases, a quick bulb change on site on a tilted back light fitting may save considerable maintenance time. To prevent the light fittings from undesired apparatus vibrations, chemically and thermally resistant silent blocks are available together with a robust tension spring fixation.

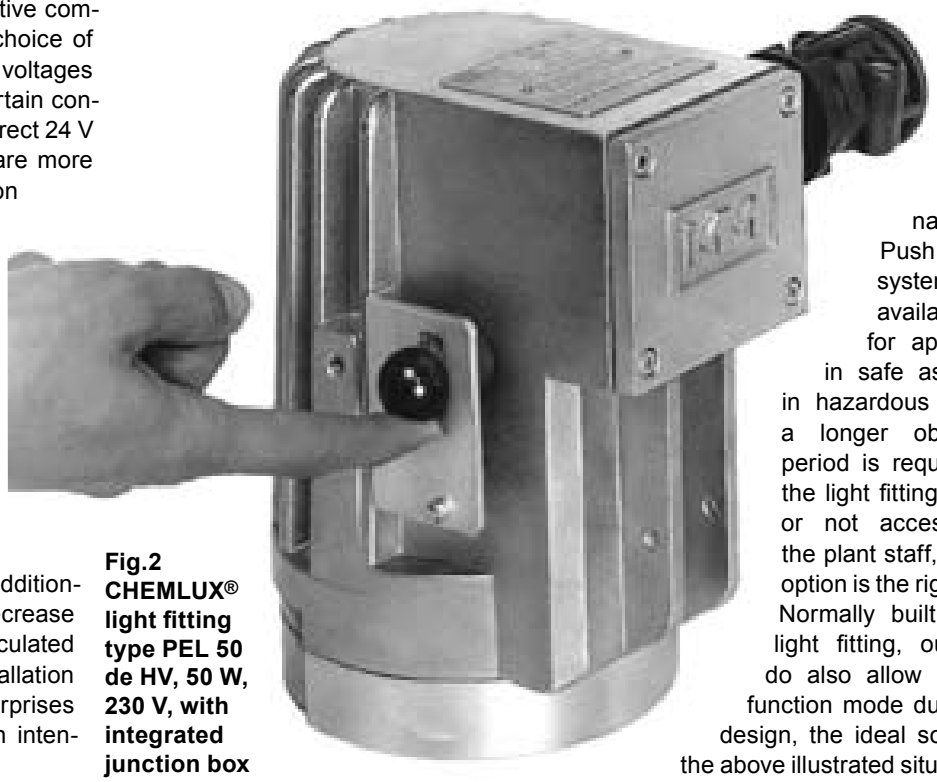

Fig.2 CHEMLUX® light fitting type PEL 50 de HV, 50 W, 230 V, with integrated junction box and internal timer „V“, Ex d e IIC T4 Gb, Ex t IIIC T130°C Db IP67, Ex II 2 G + D

The right housing material

Already during the planning phase, the choice of the housing material should be made. The most used variants are corrosion resistant aluminium alloys (advantages: convenient specific weight, good heat transfer capacity to dissipate heat losses) and stainless steel. Light fittings from stainless steel (figure 1) convince by their surface quality (an important argument for the application in sterile surroundings or clean rooms in the pharmaceutical or cosmetic industry). Not negligible is further the optical aspect. The use of a stainless steel light fitting on an equipment made entirely from highly polished steel assigns a higher value to this latter than by mounting an alumina cast light on it.

Further criteria

In choosing the light fitting, the wanted power, the desired light distribution as well as the operating mode have to be determined. One distinguishes between continuous, timed or momentaneous operation. In many cases, a very short observation of the reaction process is fully sufficient. For these applications, a push button built into the light housing is the ideal solution with one port mounting. The power consumption is extremely low and the lifetime of the bulb respectively long, facts resulting in very low electricity and maintenance costs. Push button systems are available either for applications in safe as well as in hazardous areas. If a longer observation period is required or if the light fitting is hardly or not accessible by the plant staff, the timer option is the right choice. Normally built into the light fitting, our timers do also allow a remote function mode due to their design, the ideal solution for the above illustrated situation with bad accessibility. Where staff access is no problem, the timers are available with

the acting mechanism on the light housing (fig. 2). Some of the timers may be supplied for different “on”-times of 3, 15 or 30 minutes. For light fittings for which of constructive (very compact housings) or of power data or supply voltage reasons built in timers are not available, remote timers may be supplied for safe as well as for hazardous locations, completely pre-wired in respective separate housings.

The most easy mode for a first installation is surely the continuous function. The disadvantages are a relatively high electricity consumption (especially with light fittings with high wattages) and higher maintenance costs due to more frequent bulb changes. The experience shows namely that lights of this function mode are normally switched on all day, often even unnecessarily 24 h per day, since the works staff do not switch off them when not needed.

The choice of the power to be installed often causes uncertainties. As a general rule, one should not take the size of the apparatus to be illuminated as the main criterion, but the distance between the light source and the desired observation point. If, for example, a large stirred vessel only needs observation whilst being entirely filled, but not during its discharge phase or even during its cleaning, a much less powerful illumination is required for the first of these cases than for the latter ones. As a second criterion, the internal surface quality of a vessel influences the choice: A glass lined reactor with a dark, highly light absorbing surface needs obviously more lighting power to obtain the same result as a comparable stainless steel vessel with polished internal surface. And finally, the kind of task to be resolved plays an important role: Should a chemical process need constant TV-monitoring, a much more powerful light source is necessary than if the clear outlet of a centrifuge has to be observed sporadically.

To obtain a sufficient, but not dazzling illumination of a flow indicator, the light fittings may be equiped with opaque front glass discs.

Many of the today’s available halogen-reflector-units produce either a narrow (“spot”) or wide (“flood”) light beam. The choice of one of these possibilities depends entirely on the given problem to be solved. “Flood” reflectors are mostly used for short distances between the light source and the observation point, the “spot” ones for punctual pointed illumination or for longer distances, e.g. in case of lighting out a vessel bottom whilst cleaning the tank.

Fibre-optic or “classic” light fitting?

The use of fibre-optic light fittings (fig. 3) offers new applications:

Since the light output is provided by a fibre bundle of small diameter, it is now possible to light out process equipment with very small sightglasses – and this even in the version “light and view through only one sightglass” – in cases where this was not possible with a “classic” light fitting.

On equipment being subject to strong vibrations on which the lifetime of bulbs in “classic” light fittings is rather poor, the light source can now be mounted independently apart thus reducing the transmission of vibrations to a minimum.

“Classic” light fittings mounted directly on sightglasses may cause a considerable increase of the temperature of the glass discs and therefore lead to undesired product cristallisation at their inner side hindering therefore the free insight with the version “light and sight through one sight glass”. The light output from the fibre bundle is a “cold” one therefore not producing the above mentioned phenomenon.

The light beam of a “classic” light fitting is rigidly directed into the vessel. With the flexible fibre-optic bundle instead, it is easily possible to illuminate specificly different zones of the interior of the apparatus during a process and to highlight them directly. Welded joints may so be correctly and intensively illuminated during revisions or inspections.

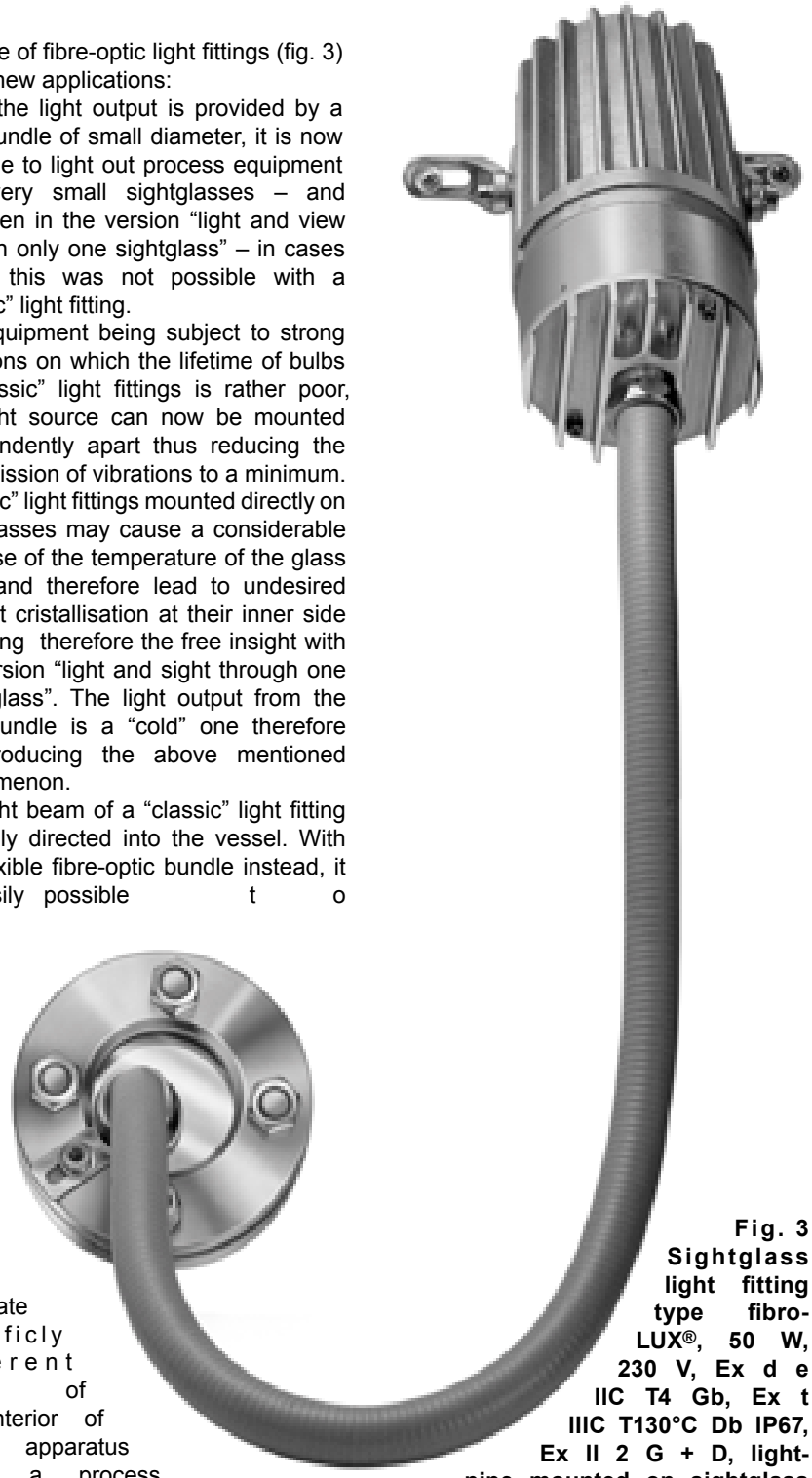

Fig. 3 Sightglass light fitting type fibro-LUX®, 50 W, 230 V, Ex d e IIC T4 Gb, Ex t IIIC T130°C Db IP67, Ex II 2 G + D, light-pipe mounted on sightglass VETROLUX® to DIN 28120, DN 25

Hazardous locations

The following criteria have to be taken into account if the light fitting has to be installed in a hazardous area.

An important pre-selection is given by the temperature class, to be determined by the user of the plant. Most production sites are classified T3 or T4, rarely T6. Since the maximum allowed surface perature class, the latter determines also the maximum possible power of a light fitting, since with higher power, besides the produced light, more heat loss energy is produced which has to be dissipated with mounting surface temperatures through the light fitting housing. This physical law may therefore cause the eventual light fitting classification into a lower temperature class (e.g. into T3 instead of T4). The user has to live with these facts, though his wish for high power and simultaneously a high temperature class registration may

be well understood. Nevertheless, MAX MÜLLER AG may supply a T4 classified light fitting with a 100 W halogen bulb for use for very difficult lighting problems, e.g. for long range lighting, for TV-monitoring or for the observation of phase separation in liquid-liquid mixtures. Another important pre-selection has to be taken regarding the ignition protection class. There are two principal possibilities available: Light fittings of the protection class “flameproof enclosure” (Ex d) without connection box or of the mixed protection class (Ex de) “flameproof enclosure” for the housing / “increased safety” for the connection box. The adjacent connection box has the advantage for the user that the supply connection may be made anywhere with a known and approved quality of cable of the right length independent of possible cables of determined length supplied with (Ex d) lights by the manufacturer. The eventually cost intensive additional installation of Ex-branching boxes is therefore obviously not necessary. On the other hand, light fittings of the protection mode (Ex d) are less expensive than those with connection box, but the installation advantages for the user do normally count for more than the difference.

Halogene or LED?

For years, LED have been emitting a green-blue coloured light. Now, LED are available which do not falsify the colours of the media to be illuminated.
The advantages of light fittings equipped with LED are as follows:
Since the temperature of the LED insert does not raise considerably, all LED light fittings are classified in temperature class T6. At the light output, the temperature only slightly increases compared to ambient temperature. Their use is thus recommended for media having the risk of cristallisation occurring at the inside of the sightglass at higher temperatures. The so-called “cold light” avoids this problem. Another advantage is the long life span of LED inserts of up to 40’000 hours. This significantly reduces the costs of maintenance. LED inserts are available in “spot” and “flood” version.
On the other hand, the price of LED light fittings is higher than for models fitted with halogene bulbs. Spare inserts are also more costly. Further, the resistance of LED inserts against higher temperatures is not as good as that of halogene bulbs, since LED are electronic components and therefore more sensitive to elevated temperatures of the sightglasses to be illuminated.
In case of any doubt or questions, please do not hesitate to contact us.