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Harmonic distortions from LED lighting in industrial buildings

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Abstract

In recent years, there was increased use of advanced light sources with electronic control gear (LED Sources). This inevitably affects the generation of harmonic pollution in the power grids for lighting.

The report presents a study of harmonic pollution in industrial power grids for lighting. The aim of the study was to analyze the impact of modern LED sources on the quality of energy in industrial lighting power grids.

Since it is usually in the industry, lighting networks have a large number of luminaires and high power, the impact of the generated harmonics on the power supply parameters is noticeable.

A particular lighting facility of a medium-sized industrial building was investigated.

The study is done with the operation of the lighting system. Various electrical parameters were measured using a network analyzer. Results are displayed after processing the measured data.

There are made appropriate conclusions from the study.

Index Terms: LED harmonics, harmonic pollution, LED drivers

1 Introduction/Einleitung

The use of LED lights is now also targeting on the industry, which, until a few years ago, has created complications and sometimes inability to use them. With the use of modern materials and electronic components, a number of difficulties have been overcome in the creation of industrial LED lighting fixtures. LED Luminaires with a very good optical system, high light output LED modules, very good cooling systems and, of course, improved power supplies are already in use.

The purpose of the study is to determine some electrical parameters of already built-in LED industrial lighting fixtures and to assess their impact on the energy system.

2 Exposition

For the purpose of this work, an industrial hall (main use is as a brewery) with dimensions 18 x 10 m and a height of 6 m is used. There are positioning 9 industrial LEDs of the type shown in Fig. 1., with the technical parameters listed in tabl. 1.

Figure 1. LED industrial luminaire Variant P60

Table 1.

Technical characteristics of the tested luminaire

Model	Variant P60
LED Chip	CITIZEN
LED Driver	Meanwell
Power Factor	> 0.95
Input Voltage	100 – 260 V
Electrical Power	60 W
Luminous Flux	7800 Lm

Type of light	DayLight
Color temperature	5000 K
Index on Color Rendering	> 80 Ra
Working range	–35 °C to +60 °C
Protection	IP 54
Operating Life	*over 50 000 h*
Body	Aluminum

In the study room was realized: average illumination 307 lx; UGR = 9; Uniformity 0.65. The lighting system meets the requirements of EN 12464 for interior lighting.

In Fig. 2 are shown data from the light technical calculations for the industrial premises.

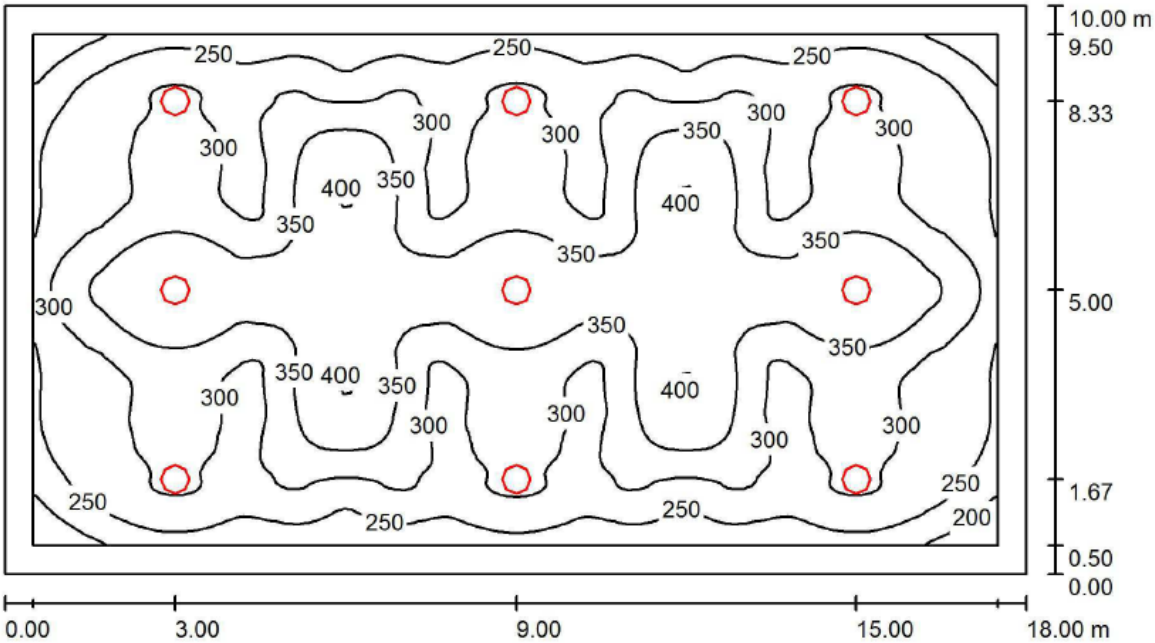

Figure 2. Results from the light technical calculations for the industrial premises

An power network analyzer - BMR Power Line Analyzer PLA33DL with very good technical parameters and good measuring accuracy, was used to study the electrical parameters of the power supply network. The measurement was carried out for one working week in the autumn-winter period, with the recording interval of the parameters being 5 minutes. The requirements of the standards EN 61010-1, EN 61000 were met.

After processing the obtained results, averaged values of the electrical parameters presented was calculated and shown in Table 2. Fig. 3.1 - 3.3 presents the graphical dependencies of the electrical parameters of the lighting system.

Table 2.

Measurement of the electrical parameters of the industrial premises

Voltage parameters

Harmonic, Y	Yu, V	Yu, %
1	224,2	100
3	1,1	0,5
5	3,8	1,7
7	0,5	0,2
9	1,4	0,6
11	0,4	0,2
13	1	0,4
15	0,8	0,4
17	0,4	0,2
19	0,2	0,1

P =	0,568	kW
S =	0,585	kVA
cos φ =	0,969	
PF =	0,917	
Q =	-0,017	kVAr

THD U =	1,9	%
RMS =	224,1	V

Current parameters

Harmonic, Y	Y_I, A	Y_I, %
1	2,77	100
3	0,61	22,6
5	0,21	7,5
7	0,11	3,8
9	0	0
11	0	0
13	0	0
15	0	0
17	0	0
19	0	0

THD I =	22,6	%
RMS =	2,75	A

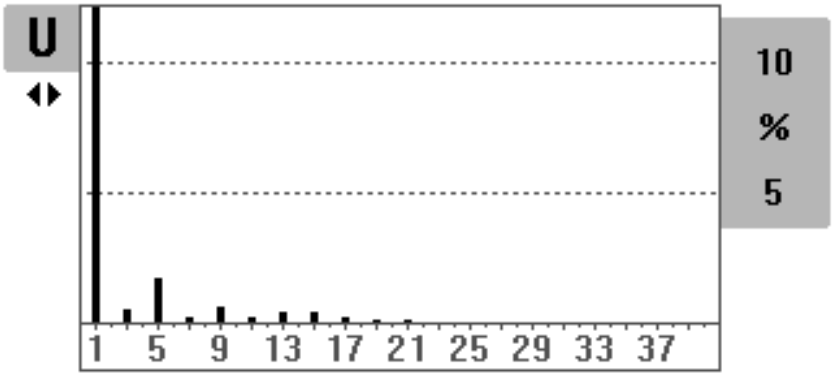

Figure 3.1. Generated Harmonic Voltage Pollution

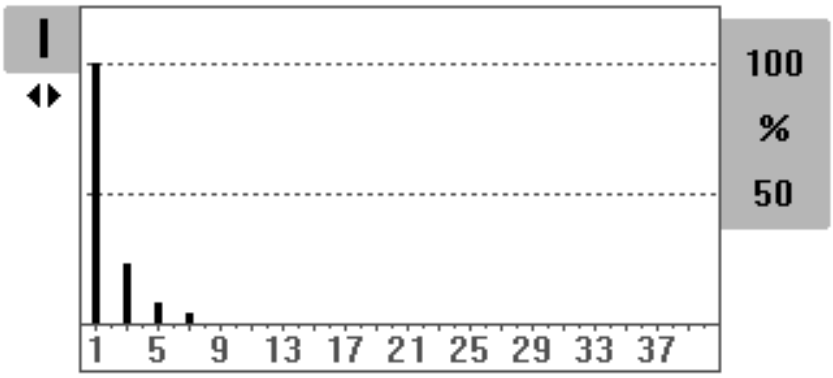

Figure 3.2. Generated Harmonic Cuurent Pollution

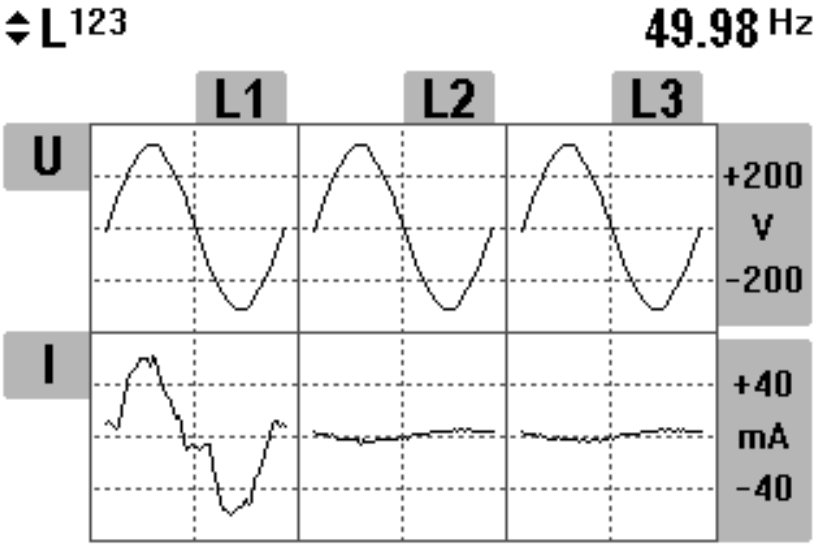

Figure 3.3. Form of the sinewave of the supply voltage and current

From the studies made it is clear that the generated higher voltage harmonics (THD U = 1.9%) are of very low value, ie. should not have a significant impact on the general power supply parameters. The harmonic current component (THD I = 22.6%) has a slightly increased value, but given the low power of the system it will not have a significant effect on the mains. This is mainly due to the quality driver used to power the LED luminaire. The realized electrical parameters cos φ and PF have excellent values close to 1.

3 Conclusion

1. The electrical parameters of a small industrial lighting system were studied. LED industrial lighting luminaires of 60 watts are used.
2. It was found that the main problem is the generated harmonic current pollutions (THD I = 22.6%), which is not very large, but with higher power of the system will affect the power supply network.
3. It has been found that with the use of a quality power module, the electrical parameters of the lighting system are close to or corresponding to those required by the standard EN 61000.

4 References

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