ESCONTER INDEX: A THERMAL SENSATION INDICATOR REGARDING HOT AND COLD THERMAL ENVIRONMENTS

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ABSTRACT

Nowadays thermal environment studies are gaining a great importance in workplaces design once individuals spend most of their time in these spaces. In this paper two case studies are presented, one in an industry affected by hot thermal environments and other in an industry which regards cold thermal environments. In both cases, the EsConTer index and PPD index were applied through MatLab algorithms that generated thermal pattern maps to understand the most vulnerable areas regarding thermal stress as well as know workers dissatisfaction. The results suggested EsConTer index as a great thermal sensation predictor which should be further valorised by industry to control thermal environments in order to satisfy most of the workers.

Keywords: thermal indexes, EsConTer, PPD, cold thermal environment, hot thermal environment.

INTRODUCTION

Atmospheric conditions changes largely affect industrial thermal environments. In Portugal, latitude nearly 40 degrees north and 8 degrees west, it is possible to experience in the same industrial chamber stressful (hot and cold) and comfortable environments. This is partly explained by solar radiation effect, which, due to the inclination of Earth’s axis of rotation and solar diurnal cycle intersects a region in different ways. In an inner industrial chamber, regarding the explained phenomena, a kind of greenhouse effect is created in the course of the day. Thus, warmer thermal environments are expected in the afternoon. Apart of these, the entire thermal sources in the space, such as thermal machines (free thermal energy), have a high impact in thermal environment changes, increasing inside air temperature when switched on. In this regard, these thermal sources should be an input to energy balance.

The study of thermal environment, associated to Ergonomics and occupational Health research fields, became popular since Fanger’s (1972) investigations with the purpose to promote a positive relation between individuals and the thermal environment surrounding. As a matter of fact, this positive relation is a key to workers’ performance, health and comfort because individuals spend most of their time in workplaces (Bluyssen et al., 2011).

Individuals’ thermal environment perception is performed by their thermal sensation which uses human body thermal sensors, such as skin, commanded by hypothalamus and regulated through human body thermal regulation and behavior. A comfortable thermal sensation is considered as the satisfaction state of an individual when exposed to a certain thermal environment. Contrarily, a stressful thermal sensation is defined as the dissatisfaction state of
an individual when exposed to hot or cold thermal stress environments (Talaia et al., 2014). The biggest issue in thermal comfort study regards thermal sensation by its subjectivity. Thermal sensation does not depend exclusively on thermal factors, such as air temperature and air relative humidity but also on personal factors, for example, age, culture, eating habits and gender which greatly affect individuals’ response to thermal environment surrounding.

Accordingly, in this paper two case studies are presented, one performed in a glass industry (industry 1) affected by hot thermal environments and other in a fish processing industry (industry 2) which regards cold thermal environments in order to study workers thermal sensation regarding a very recent thermal index, EsConTer (Talaia & Simões, 2009) and PPD (ISO 7730, 2006).

RESULTS AND CONCLUSIONS

From an algorithm created in MatLab, both of the indexes were analysed though generated colour maps, as shown in Figure 1. Regarding the Figure 1 it is possible to visualise that in industry 1 the thermal environment range fluctuate between comfortable and slightly warm environments and in industry 2 between slightly cool to cold.

![Fig. 1 - Thermal sensation pattern and dissatisfaction sensation pattern given by EsConTer and PPD.](image)

The results suggested EsConTer index as a great thermal sensation predictor which should be further valorised by industry to control thermal environments in order to satisfy most of the workers comfort, health safety and performance needs.

REFERENCES


