SAFETY MONITORING SYSTEMS OF DANGEROUS ENVIRONMENTS FOR THE IMPROVEMENT OF WORK SAFETY LEVEL

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Abstract **– This paper presents an overview of a monitoring system for dangerous work environments in order to prevent work accidents and work-related illness. There are identified and analyzed different methods of monitoring the work environment. Also is presented a proposition for such a computerized monitoring system.**

Keywords: *Monitoring system, risk factors, work accident, work-related illness.*

1. INTRODUCTION

European Union statistics proved that during a year of the last decade, from 120 million people hired approximatively 5 million were the victims of an work accident that determined a temporary inability longer than 3 days. Every year in these countries 6000 work accidents end with the death of the workers.

Each accident means physical an mental sufferings, income losses for those involved – victims, family, friends, but also a lost of working time for the company where the accident occurs and the society. At a global scale, investigations made by the International Labour Bureau indicate a high cost for work accidents ant work related illnesses to 1% of the Gross Domestic Product, while the total losses caused by these events in well developed countries totalizes 2-4%.

A very useful tool for reaching the highest degree of security is the use of these monitoring systems of work environments with a high level of risk.

2. ENVIRONMENTAL MONITORING

2.1. Stress factors effects

The work capacity is dependent of the way which the man integrates in the work process and the factors that manage this process (fig.2.1):

- Anatomy (organic and functional structure, sex, age, health)
- Psychological (work motivation, skills)
- Psycho-social (interpersonal relationships, level of culture and professional grounding)
- Work Environment (activity, technology, risk factors)
- Earned skills (exercise and training are the most important)
- Sanogenetic measures
- Work adaptation, time, rhythm and regime of work;

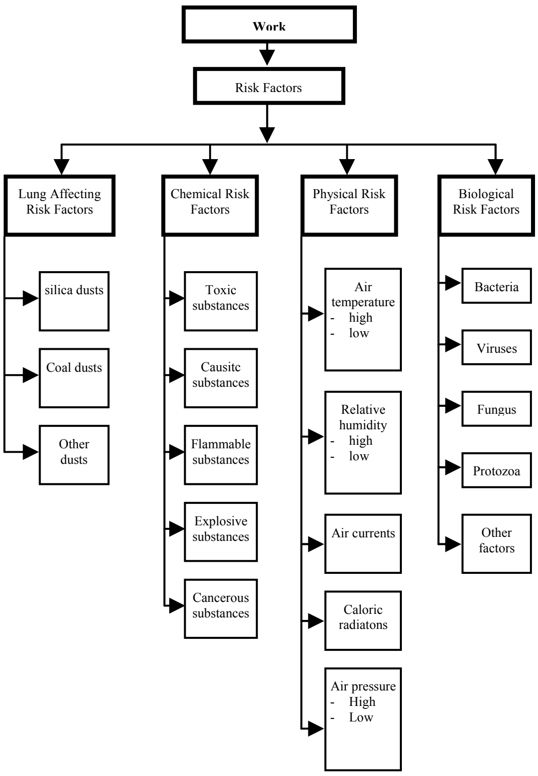

Figure 2.1. Environmental Risk Factors.

2.2. Microclimate Monitoring

Microclimate represents the total amount of physical factors of air (temperature, humidity, currents, caloric radiations) at the work place in a limited space.

Professional microclimate can be determined by measuring the physical parameters of air at the work place and assessing the human body metabolism.

Ambiental physical risk factors can be done with classical instruments (sphere-thermometer, Assman psihrometer, anemometer, catathermometer) but also with electronic sensors that measure air's dry temperature or the speed of air currents using specially designed probes.

2.3. Lighting monitoring

Proper lighting at the work place prevents professional weakness, increase the work capacity and prevents eye related diseases and work accidents.

Professional lighting determination is made by using the luxmeter. This is a device containing an selenium photoelement and an galvanometer that records the photocurrent generated by the light flux that drops on the photoelement.

The stress of the visual analyzer can occur at the work sites where the lightning is not uniform, the intensity of light is not good enough, where sparklings occur or where is an dusty environment.

One of the best ways of improving lighting and at the same time cutting power consumption and costs, is by better lighting control, for instance by dimming or switching off lights as daylight increases and, equally important, increasing the lights or switching them on as daylight fades. The light can be measured with a photo-electric cell or a digital lightmeter, and the results can be processed and decisions can be made automatically. A subsystem for monitoring light should look like the one in the figure 2.2.

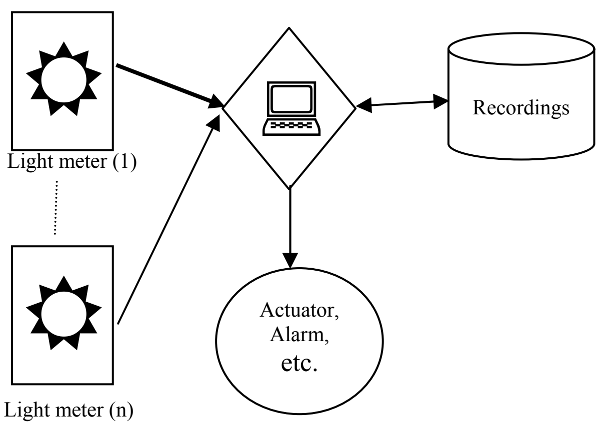

Figure 2.2. Subsystem for Monitoring Light

2.4. Noise monitoring

The noise produces in the work environment can be constant – it's intensity doesn't variates during the working day – or variable, either during a day, or during a week.
The constant noise level is determined by measuring the continous equivalent accustic level during daily noise exposure time – the accustic level (in dB) and which has a similar effect to the variable noise measured at the work place.
The professional noise represents a complex of sound with different parameters, produced by devices, machinery, human voice during the professional activity. There are two types of situations concerning the noise exposure: unhealthy noise for the internal ear or unhealthy noise for the attention of the employee.
The measurement of professional noise is made using these devices (fig.2.3):

- Sonometer, which implies a microphone for retrieving of sounds at the work place and a measurement device for transforming the sounds in electrical signals – recommended for the constant level of noise;
- Integrator sonometer – recommended if the noise presents fluctuations, with different timings of exposure;
- Noise dosimeter.

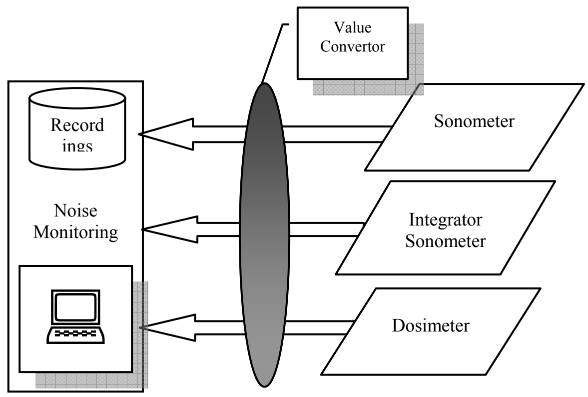

Fig.2.3. Subsystem for Monitoring Noise

2.5. Mechanical Vibrations Monitoring

Mechanical vibrations are oscillatory movements with infrasonorous or partially sonorous frequencies. They can be classified as follows:

- o periodic mechanical vibrations:
  - simple, periodic oscillations present a sinusoidal form;
  - compound, oscillations repeat themselves systematically;
- o non-peridoc mechanical vibrations, that have no rhythm of determined oscillations:

- free oscillations;
- forced oscillations.

These vibrations can be undesirable, resulting as a malfunction of a machine, or wished for, resulting as the energy used for the normal functioning of the device.
In order to assess the potential risks produced by these it is needed the measuring of trepidations at the work site and assessing the exposure in time.
The spots where the measuring of vibrations takes place are: movement machinery, foundations, pedestals, or different parts of the human body.
For an daily exposure of 8 hours, E.U. Commission recommends a limit of total level-headed acceleration of 0.5 m/s2.

2.6. Chemical Substances Monitoring

Chemical substances, with which the worker comes in contact during his work are called professional toxics, and therefore can be classified by their destination in the work process:

- primary materials; intermediary products; end-user products; impurities (natural or accidental); collateral products (carbon monoxide).

The indicators that are determined in the worker body are:

- o internal exposure, that proves the presence of the toxic in the human body without producing biological effects;
- o biological effect, that proves the presence of the toxic in the human body and it has an undesirable effect.

The rational assembly of dynamic macromolecules, biocomponent stability, DNA based biosensors, molecular beacons, electronic nose, multianalyte-transducers, sensor systems and others are now used as tools for environmental monitoring. The recent works in chemical and biological sensors are meeting the challenges of environmental monitoring through enhanced specificity, fast response times, and the ability to determine multiple analytes with little or no need for sample preparation steps in complex samples. Gas sensors are the most common digital or analogic devices met in monitoring chemical substances, or unhealthy vapors.

2.7. Professional dusts monitoring

The dusts are measured at the respiratory level of the worker. This is represented by a sphere with 1m diameter around the head. The sample can be obtained using various methods: filtration, humidification, impact, electrical precipitation, thermal precipitation.
In continuous technological processes more samples are needed, that are made at the beginning, middle and end of the shift, even before ending. In discontinuous processes, the samples are harvested during every phase, especially those that are emitting dusts.

3. OVERVIEW STRUCTURE OF AN MONITORING SYSTEM FOR DANGEROUS WORK ENVIRONMENTS

A system for monitoring dangerous environments should have a real-time response in order to provide the proper protection measures to the workers. Such a system should have enough subsystems for ensuring that all the possible critical situations are accordingly treated in order to eliminate or diminishing any risks involved. The software that controls this system must be well programmed, without leaving the possibilities to misjudge any cases. The design must have a good communication bus in order to sustain the large amount of data that are transmitted between the subsystems.

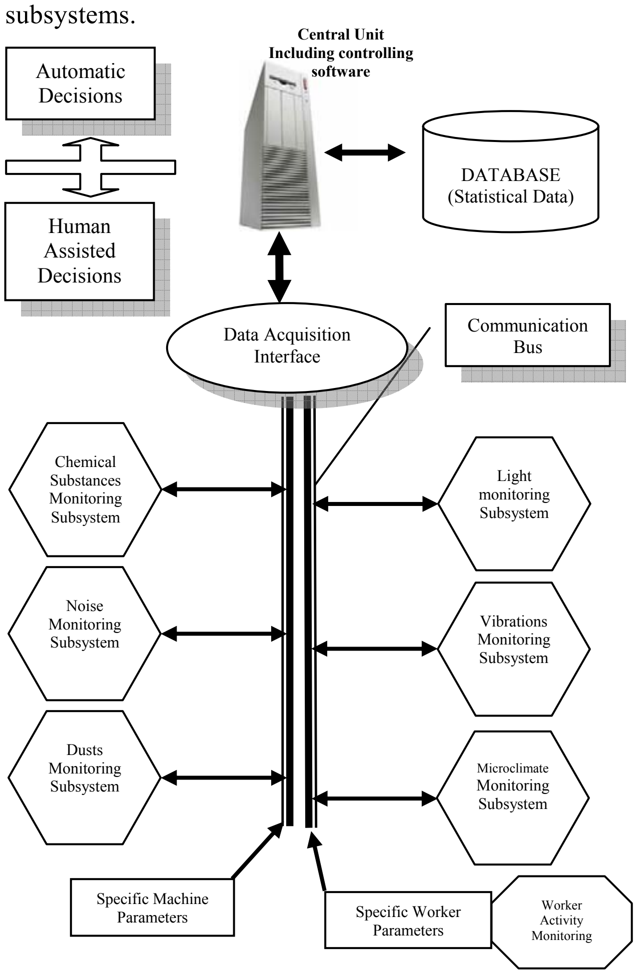

Fig.3.1. System for Monitoring Dangerous Environments

Any automatic decisions could be made on-site in the subsystem, but others should need the human intervention and could depend on other subsystems, therefore the central unit that controls everything is very important. The statistical data provided by the history of the events, malfunctions, etc. is also of interest because on this basis there can be made decisions about the safety of technological processes. Figure 3.1 illustrates a basic design of such a system including all subsystems depicted above.

4. CONCLUSIONS

Dangerous environment monitoring can be done using either classical methods, which need a longer time to process and high level of human intervention, but also using latest state of the art technologies, increasing the precision of measurement and eliminating the human subjectivity, lowering the reaction times and increasing the level of work safety.

The technology becomes more accessible and cost effective and such systems are more affordable than using humans for monitoring and assessing the risk factors in work environments.

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