THE EVALUATION OF PERFORMANCES OF INSTALLATIONS BY POWER PLANTS FROM ROMANIA CONCERNING PROFESSIONAL RISKS – CASE STUDIES ROVINARI POWER PLANT

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ABSTRACT

Numerous places where the employees work in noxious environment still exist within the thermal power plants from Romania. The objective of this paper is to find out some modern technical solutions, which eliminate or diminish as much as reasonably possible the chemical and physical noxes and establish some measures aimed at reducing the exposure of the power sector personnel to the noxious environment.

This paper describes the evaluation of a real situation by help of the modern methodologies for the identification and monitoring of the physical and chemical noxes from two Romanian thermal power plants, the analysis of the health condition for the employees exposed to such physical and chemical noxes and it establishes, in the end, the risks of the occupational exposure.

The examination of the workplaces is intended to establish the level of the noxes and take some measures for converting the risks into non-risks or smaller risks through the cognition of the noxious factors existing in the environment of the workplaces and, last but not the least, the cognition of the measures aimed at reducing, preventing, eliminating the occupational risks.

Identification of the places with a high noxious level and the preparing of the technical-organisational solutions for the improvement of the physical and chemical noxes exhaustion and elimination, including also the impact of their application financial costs represent all factors of major importance for lining up the occupational noxes levels with the national and European standards.

Through the implementation of the technical solutions for the attenuation of the occupational noxes a major desiderata is provided for lining up with the Regulations of the European Community concerning the increase of the life quality in the workplaces from the energy industry.

KEYWORDS

power plants, risks, installations, noxes

1. INTRODUCTION

Numerous places where the employees work in noxious environment still exist within the thermal power plants from Romania. The noxious environment can be more or less injurious to the personnel exposed depending on the concentration, exposure duration and constitution or the

subjects exposed.

Until the present moment a number of specific measures have been established in order to reduce or remove noxes with a view to prevent the employees to fall ill; nevertheless the results have not always been the expected ones.

In order to provide the corresponding conditions for the labour safety and health in the energy sector, it is necessary to apply, on the one side, some local organisational measures which lead to the operation of the existing equipment under conditions of tightness while maintaining the cleanliness at the workplace and to take, on the other side, some technical measures by introducing new installations or apparatus to reduce noxes under the maximum acceptable value, maintain the cleanliness at the working place or keep away the personnel from the noxious environment.

The objective of this paper is to find out some modern technical solutions, which eliminate or diminish as much as reasonably possible the chemical and physical noxes and establish some measures aimed at reducing the exposure of the power sector personnel to the noxious environment.

The examination of the workplaces is intended to establish the level of the noxes and take some measures for converting the risks into non-risks or smaller risks through the cognition of the noxious factors (and the risks due to them) existing in the environment of the workplaces and establish the measure specific for the collective and individual protection and, last but not the least, the cognition of the measures aimed at reducing, preventing, eliminating the occupational risks.

The paper is a novelty due to the approach of a new fundamental & applied research topics (reduce the impact on the environment and improve life conditions through the implementation of the non-polluting technologies) in the workplace health and safety domain and through the replacement of the old, heavy and deficient technologies from the point of view of the operation, technology, control and efficiency with modern technologies (de-dusting installations) used abroad currently.

When examining an industrial enterprise from the toxicological point of view, the workplaces supposed to be included within special conditions should be identified while the determination of the occupational noxes should be made only following a Study of the Technological Process. It refers to the detailed cognition of the raw materials and materials, finished products and intermediary products, equipment and technological process, operation of the respective equipment and tasks of the persons exposed.

On the basis of the Technological Process Study noxes to be determined will be fixed taking into account the fact that they can come from any chemical substance participating in the investigated process.

Analysis of the noxes exposed employee health condition is essential for the accurate establishing of the measures aimed at preventing the personnel exposure to occupational noxes.

Special attention should be focused on the chemical substances that occur randomly because of the impurities existing in the various reagents added in the substances that appear as wastes because the toxicity of these products is sometimes higher than the one of the substances they derive from.

At the identification of the noxes there will be taken into account the physical-chemical properties, such as; the state of aggregation (vapours, gas or suspended matters, aerosols or dust), boiling point, vapour pressure, solubility because the cognition of these parameters determine the working methods to be used.

In case several noxes are simultaneously present in the same workplace, after the identification of such noxes, a classification and hierarchy of them will be made while taking into account their cumulated and synergetic action upon the human organism, establishing thus the level of risk it has on the personnel.

2. MATERIAL, METHOD, RESULTS

2.1 Chemical factors

Chemical sampling for SC COMPLEXUL ENERGETIC ROVINARI SA was made in accordance with the HG nr. 1218 / 06.09.2006.

Sampling and determination chemical samples in the work places was made in accordance with Romanian norms. The Romanian norms are :

- HG nr. 1218 / 06.09.2006,
- Methodological Norms for Labor Medicine / 1996,
- Investigation Methods in Labor Medicine /1995.

Instruments used for determinations were:

* for sampling the specimen :

✓ Casella and SKC own pumps

✓ Multiwarn-Drager gas analyser with specific electro-chemical sensors of the Drager Senzor XS ECNO – 68 09 125, EC CO – 68 09 005 type.

✓ Whatman glass fibre filters

✓ absorbers and micro-absorbers

* for determination:

✓ spectrum-photometer UV/VIS Pye Unicam SP6-550

✓ Mettler analytical balance

✓ Drager indicating tubes.

Principles of the methods to determine the chemical substances are:

- For the determination of CO, NO_x from the atmosphere of the working zones there has been used a gas analyser of the Multiwarn-Drager type with specific electro-chemical sensors of Drager Senzor XS ECNO – 68 09 125, EC CO – 68 09 005 type. The Drager electro-chemical sensors measure the partial pressure of the sampled gases. The noxes monitored diffuse through the membrane of the electrolyte containing a sensible electrode specific for each gas to be determined. The signal of the electrode is converted in electric signal and registered on the display of the analyser.
- To sample the aliphatic hydrocarbons the air sampled is aspired at a flow rate of 1,5 l/min. through an absorber containing 10 ml ethylic alcohol for 10 minutes; read it in UV at 255 nm wavelength;
- Drager indicating small tubes are used for sampling the ozone;
- Hydrochloric acid enters reaction with the SCN^- ion (from the potassium sulphur-cyanide) resulting in a weak dissociated compound $(HgCl_4)^{2-}$, which in the presence of the ferrous-ammonia alumen gives birth to a red calorimeterable compound.
- Toluene shows an absorption maximum in UV at 261 nm, through the absorption in ethylic ether;
- ammonia is determined with Nessler reagent, resulting in amidooximercuric iodine and amidomercuric triiodine of yellow colour, calorimeterable at λ=450nm;
- hydrazine enters reaction with p-dimethylaminobenzaldehyde, resulting in a coloured compound with calorimeterable quinoidic structure, calorimeterable at 470nm;
- natrium hydroxide (NaOH) enters reaction with the sulphuric acid solution that is put in evidence with bromcresol green solution in the turning domain of pH=3,8-5,2 and the modification of the colour from green into blue followed by the measuring of the extinction at 617nm;
- mineral oil air emulsions sampled in chloroform evidence an absorption maximum in UV at λ=265nm;
- dozing of trichloretylene through the absorption in UV at λ=210nm, in ethylic alcohol;
- sulphuric acid (H_2SO_4) is determined from the reaction of SO_4^{2-} nitrogenous lead, nonfelometerable at λ=420nm;
- ethylic ether is oxidised with a potassium dichromate acid solution. With the spectrophotometer appraisement of the dichromate consumed in this oxidation as related to a

known quantity taken in work, the quantity of ethylic ether entered in the reaction is deduced. Extinction is measured at λ=430nm;

- the total of the powders retained is determined with CASELLA - Aerosol Monitoring System AMS950 type for power retaining.

2.2 Physical and physical-chemical noxes

2.2.1 Presentation of the methods for the determination of the noise and powders and of the utilized measurement instrumentation

The investigation of the work places within a thermal power plant has aimed at establishing the level of these noxes and comparing them with the maximum allowable limits established by the legislation in force in the field.

The methodology for carrying out the powder measurements is based on the norms and standards in the field . The measured values have been compared with the maximum values allowed by GD 1093 / 16.08.2006.

The measurements have been carried out by means of the **CASELLA – Aerosol Monitoring System, type AMS950,** S/N 035390. The **Aerosol Monitoring System** - **AMS950** is designed for monitoring the air in the areas where it is necessary (dust, fibers, smoke, mist, a combination of them, etc.). It is equipped with a probe that can be removed making possible that the measurements be performed in relatively difficult to reach areas (narrow places).

For the noise determinations, the methodology for carrying out the measurements is based on norms and standards in the literature. The measured values have been compared with the maximum values allowed by GD 493 / 12.04.2006.

The measurements have been performed for each workplace in the points where the personnel has to carry out different maneuvers or different other activities specific to the technological process.

The determined values of the noise have been compared with the maximum allowable value, **87 dB (A**) according to GD 493/12.04.2006 /- the maximum allowable limit in the work places for the daily exposure to noise.

The noise measurements have been carried out by means of the **BRUEL & KJAER soundmeter type 2204** equipped with a ½" microphone for the noise measurements and by means of vibration transducers for the vibration determination (acceleration).

2.2.2 Presentation of the lighting determination methods and of the utilized instrumentation

The value reporting for the determination of lighting conditions in the work places from a thermal power plant running on solid fuel has been carried out according to SR 6646-2/1996.

SR 6646-2/1996 has been developed according to the international and national regulations (from the point of view of the physical noxes by workplace). Mention should be made of the following:

- SR 6646-1/1996: Artificial lighting. General conditions relating to interior lighting and lighting within the building assemblies.
- STAS 8313/92: Lighting inside the buildings and of the exterior spaces. The lighting measurement and average lighting determination method;
- SR 12294/1993: Artificial lighting. Lighting in industry.

The methodology for carrying out the measurements is based on the norms and standards in the literature. The measurements have been carried out according to standard SR 6646-2, "Artificial lighting – Conditions for the work areas lighting" This standard establishes the conditions for the normal artificial lighting of the work places that observes:

- safety of the personnel at work and moving around the areas with this destination;

- easy, quick and accurate determination of details characteristic of the visual tasks by persons with a normal eyesight or adequately corrected.

The lighting measurements have been performed by the digital luxmeter **MAVOLUX 5032 /C/B USB** from ICEMENERG's endowment.

The lighting measurement instrument **MAVOLUX 5032 /C/B USB** is a highly accurate and easy to handle instrument. It enables the accurate measurement of lighting in lx or fc. The light sensor is color corrected, meaning that the spectral response capacity has been matched to that of the human eye V (λ).

The instrument is equipped with a data memory with 100 locations that can be read and processed directly with keys and a display, but also through the incorporated USB port delivered with the instrument.The measured values have been compared with the above mentioned values SR 66646-2 standard: " Artificial lighting – Work places lighting conditions"

3. THE RESULTS OBTAINED ENABLE US TO DRAW THE FOLLOWING CONCLUSIONS:

3.1 For the chemical noxes:

- The analysis of the chemical noxes has been performed according to Decision no. 1218 of September 6, 2006 on "The establishment of the minimum requirements relating to occupational safety and health for the workers' protection against the chemical agents risks"
- The results of the determinations carried out in the Chemistry Section – ammonia and hydrazine preparation - underline the risk of exposure to ammonia and hydrazine, the ammonia limit value has been surpassed 1.16 times within 8 hours and in the case of hydrazine 2.1 times.
- The results of the determinations carried out in the Chemistry Section – coagulation installation at 0 m level point out that the values for NaOH and NH3 are very close to the limit values within 8 hours.
- The results of the determinations performed in the Chemistry Section – coagulation installation level -4.5 m point out that the values for NH3 are very close to the limit value within 8 hours.
- The results of the determinations performed in the Chemistry Section – Laboratory for the solution preparation point out the risk of exposure to ammonia, surpassing the limit value for ammonia by 1.1 times in 8 hours, as well as the exposure to NaOH which surpasses the limit value by 1.24 times in 8 hours.
- The results of the determinations carried out in the Electrical Shop – The Winding Section – point out that the values for toluene are close to the limit value within 8 hours.
- The results of the CO2, SO2, NOx determinations carried out at the work places in the respective power plant point out that the chemical noxes have not surpassed the limit values. Mention should be made that the registered values of the chemical noxes are those registered at the moment the different technological operations have been performed.

3.2 For the physical and physical-technical noxes

The measurements of the artificial lighting have been performed according to SR 6646-2/1996 in the measurement places required by the beneficiary. The values measured by the measuring team should be correlated with the design diagram (in case there are less lighting sources than required by the standard, artificial lighting sources will be mounted in order to observe the values required by the standard.)

- The methodology for carrying out the powder measurements is based on the norms and standards in this field, the measurements will be carried out according to the procedure PO-SME-

08 “Determination of the particle content by means of the gravimetric method”. The measured values have been compared with the maximum values allowed by GD 1093/16.08.2006.

• The methodology for carrying out the noise measurements are based on the norms and standards in the field, the measurements being performed according to the PO-SME-14 procedure “ Determination of the noise level”. The measured values have been compared with the maximum values allowed by GD 493/12.04.2006.

• The work places that have been investigated from the physical and physical - chemical points of view (powders, noise) are located both indoors in closed spaces and outdoors, in a configuration specific to each operation section and to the specific technological process carried out there.

• During the performed technological process a great amount of dust is generated in the work places of the personnel that operate the equipment. The concentration of the dust varies with the technological process. In all the situations great amounts of dust are generated whose concentration surpasses the allowable concentration established by the standards in force. The installations and equipment that do not generate dust in amounts surpassing the permissible limits function normally.

• At the same time for the normal functioning of the equipment and installations levels of noise surpassing the allowable limit (87dB(A) have been established.

• The measurements of the powders and noise have been carried out for each work place in the points where the operating personnel has to carry out different operations or different other activities specific to the technological process.

4. RESULTS OBTAINED FROM THE HEALTH CONDITION INVESTIGATION FOR THE EMPLOYEES FROM ROVINARI POWER PLANT

4.1 Chemical Treatment and Electric Sections:

In the chemical treatment section the workers are occupationally exposed to the irritant gases (HCl, ammonia, hydrazine).

The clinic examination per apparata and systems, evidenced the following:

- Tegumentes and mucous membranes – pale tegumentes ;
- Osteoarticular apparatus – lumbodynia;
- Respiratory apparatus – inter-current respiratory disorders;
- Cardiovascular apparatus - palpitations, dispnoea;
- Digestive apparatus – dyspeptic syndrome.
- Urigenital apparatus – uterine fibroma, vesicle disorders;
- Nervous system – neuro-vegetative and sleeping disorders.

From the analysis of the data, predominant digestive and osteoarticular disorders and diseases have resulted.

4.2 Electric Operation & Repairing Section

In the electric section occupational exposure to irritant gases (H_2SO_4), powders, noise, unfavourable microclimate and vicious positions exist. 70% of the jobs are held dominantly by electricians.

The clinic examination per apparata and systems evidenced the following:

- osteoarticular apparatus – disorders of the lumbar column, polyarthritis, gonarthrosis.
- cardiovascular apparatus – precardialgia, cardiac disorders in APP
- digestive apparatus

From the analysis of the data, there results that the osteoarticular disorders are dominant.

4.3 Turbine & Boiler Repairing Sections

In this section occupational exposure to irritant gases (ammonia and hydrazine), powders, noise, unfavourable microclimate, vicious positions exist.

The clinic examination per apparata and systems evidenced the following:

- hearing apparatus – hearing deficiencies.
- nervous system – sleeping disorders, nervousness state, paresis in the inferior limbs
- tegumentes and mucous membranes – eruptions of tegumentes, conjunctivitis;
- osteoarticular apparatus – effort based lumbodynia, polyarthralgia and crackments at the mobilisation of the big articulations
- respiratory apparatus – bronchitis like disorders
- cardiovascular apparatus – pains of angina type.
- digestive apparatus – symptomatology of the gastroduodenal ulcer - dyspeptic syndrome type.

From the analysis of the data there result the following:

- hearing deficiencies evidenced as low hearing level at one or two ears, of unilateral or bilateral deafness type
- osteoarticular disorders prevail
- digestive disorders of the chronic gastroduodenite or gastroduodenal ulcer type
- respiratory disorders with bronchitis specific manifestations

4.4 Hydro systems workshop

In the hydro systems workshop, workers are exposed to the noise and powders

The clinic examination per apparata and systems evidenced the following:

- teguments and mucous membranes - pitiriazis;
- osteoarticular apparatus – polyarthralgia and crackments at the mobilisation of articulations
- endocrine system – spasmophilia.

4.5 Coal mill-repairing section

In the section where coal mills are repaired, the workshops, central belt conveyers, crushing I,II,III, include the occupational exposure to dust, noise, unfavourable microclimate, physical efforts.

The clinic examination per apparata and systems evidenced the following :

- osteoarticular apparatus – polyarthralgia arthralgia, lumbodynia, crackments at the mobilisations of the big articulations.
- respiratory apparatus - nasal obstruction, irritate dry cough;
- cardiovascular apparatus - HTA;
- digestive apparatus - dyspeptic syndrome;
- urigenital apparatus – hypothyroidia, spasmophilia;
- nervous system and analysers – sleeping disorder, visual acuity disorders.

Analysis of the data obtained from the clinic examination indicates that 42.5 % from the investigated subjects have osteoarticular disorders represented by lumbodynia and polyarthralgia, out of which 52.8% are males and 41.2 % females; 52.9 % work in the respective workplace for about 11-20 years and 47 % work there for less than 10 years, while 17.6 % have osteoarticular pathological antecedents.

20% from the subjects presented dyspeptic like digestive disorders, 50 % are males and 50 % are females, 65.5 % are smokers; 37.5 % are alcohol drink consumers; 50 % from the subjects that have digestive troubles work in the respective workplace for 11-20 years, and 30 % from the subjects have antecedents of the acute viral hepatitis and gastroduodenite type.

4.6 Mechanics Workshop

In the mechanics workshop the occupational exposure is predominant with noise, powders, vicious positions.

The clinic examination per apparata and systems evidenced the following:

- osteoarticular apparatus – articulation mobilisation crackments, lumbodynia, polyarthralgia;
- respiratory apparatus - accentuated vesicle murmur, effort dispnoea;
- nervous system and senses – eyesight disorders.

Analysis of the clinic examination data evidences 83% affecting of the osteoarticular apparatus with lumbodynia and arthralgia disorders, 66% from the subjects are over 40 years in age and work in the respective workplace for about 10 years.

4.7 Heavy equipment section

In the heavy equipment section the dominant occupational exposure is to noise and carbon oxide.

The clinic examination per apparata and systems evidenced the following:

- osteoarticular apparatus - rachitis remains, lumbago [discopatia];
- respiratory apparatus - cough with expectoration, pulmonary emphysema;
- cardiovascular apparatus - HTA with extrasystoles , mitral stenosis;
- digestive apparatus - dyspeptic syndrome;
- renal apparatus - urinary infection:
- nervous system - neurotic syndrome.

Consequently, at Rovinari power plant the following problems are specific for the health of the employees :

From the global analysis of all the data obtained from the investigation of the working conditions in correlation with the results obtained from the clinic and paraclinic medical examination, there appear a preponderance of the muscle-bone system disorders which are found in the sections and workshops: crushing, conveyer-belts, coal mill repair and mechanics workshops. This situation can be related to some working factors, such as: air currents, temperature variances, physical efforts. However the structure of the lot investigated indicates a majority in excess of 60 % subjects that are more than 30 years old. This issue suggests that in the ethnology of the respective disorders, the ageing physiological factors, through the wear of the articulations, degenerative inflammatory disorders, are the main roots of the respective morbidity category.

There has been found out a relative high percentage, namely 17.9 % of the subjects with respiratory function disorders. Most of these functional disorders are minor, respectively slightly restrictive non-functionality and minor diseases of the air ducts. While correlating the workplaces and the originating places of the subjects, there has been found out that more than 50% of the workers are coming from the crushing, boiler-turbine, belt-conveyer. In these sections, the highest concentrations of powders have been also determined.

Another argument to the sense of the occupational influence in the ethnology of these health disorders is the presence of the irritant type symptomatology (dry coughing mainly) is dominant with the subjects that originate from the perimeter of the same above-said sections and workshops. At the same time, there has been found out that only 18 % from the subjects investigated wear constantly the protection equipment.

Professional accurate diagnostics have been not possible because the smoking also causes the same medical manifestations. The data resulted from the investigation indicate that a large number of the subjects are cigarette smokers. Moreover in some sections or workshops all the workers are smokers. The tested lot evidenced that 53 % from the subjects are smokers. The analysis of some reference parameters of the respiratory functional tests, such as VEMS and MEF, evidences that the highest deviations from the normal values are at their highest proportion in those places where the highest proportion of smokers is. Otherwise, even in the lot investigated

17.9 % from the subjects that have disorders of the pulmonary functions, more than 87 % are smokers and all of them work in the respective workplace for more than 15 years.

Audiometer examination of 106 employees from the sections where the noise exposure is the highest evidences 8 subjects with hearing deficiencies. These subjects come from crushing, coal mills and turbines.

The psychological examination made with the above mentioned neurobehavioral battery tests evidenced modifications of the parameters, in more than 50% of the subjects originating from the crushing, coal mills, belt-conveyers, turbine sections. The most affected parameter has been the (visual and hearing) reaction time [feedback]. This situation is correlated with the noise factor existing in these workplaces.

A problem that requires special attention refers to the analysis of the carboxyl-haemoglobin. The sampling of the specimen from the subjects was made at the workplaces at the end of the shift III where 60 mg/m^3 CO concentrations have been found out.

At 4 subjects from the tested lot there have been found concentrations exceeding 10 % carboxyl-haemoglobin from the total haemoglobin. Although the number of smokers in this sub-lot is not very high (more than 85 %) the correlation with the high value of CO in the working environment cannot be avoided, being known that smoking only cannot touch such thresholds. Some programmes are recommended for the improvement of the ventilation systems and awareness of the employees in the relation with the workplaces**.**

The obligations referring to the periodical examination of the employees via medical investigations and analyses specific for the working conditions where the workers carry out their activity take place in a scheduled manner. At present the technical endowment of the medical unit of the enterprise is convenient and adequate.

5. TECHNICAL AND TECHNOLOGICAL SOLUTIONS PROPOSED FOR THE ATTENUATION OF THE OCCUPATIONAL NOXES FROM POWER PLANT :

5.1 Chemical Section

a) Eliminate chemical noxes from the demineralisation-softening room and NaOH pumps from the regeneration node, hydrazine preparing and dosing room, ammonia preparing and dosing room:

Technical solution:

Static ventilation system using the natural convection principle

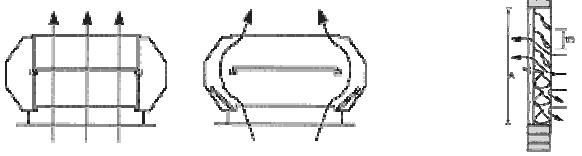
The benefits of this system are:

- natural ventilation through convection;
- extraction of the occupational (chemical, physical-chemical) noxes;
- maintain the roofs clean and luminous.

The actual construction of the chemical section does not offer optimal conditions for the natural ventilation; this fact is usually omitted from the execution plans and design.

The ventilation system for noxes extraction is provided with:

- folding valves for any meteorological conditions
- metal, aluminium, glass or insulating material networks of a design that reduces the resistance of the air eliminated.



The ventilation system for noxes extraction can be mounted either on the roof or in the walls.

b) Elimination of the chemical noxes from the chemical labs (pre-treatment, demineralisation-softening shift, reagent preparing, water analysis, oil, fuel oil analysis labs):

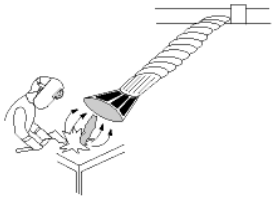
Technical Solutions:

1. Execution of the lab niches should be made of corrosion proofed materials (polypropylene, stainless steel)
2. NOx removal system from the niche should be of the hood type provided with active carbon filters which can be replaced regularly
3. Niches should be better sealed through the construction of rail-mounted windows provided with rubber edge and termopane window.
4. At the lower part of the niche there should be made a system for the introduction of an additional fresh air current which facilitates a better circulation of the air.

c) Elimination of the chemical noxes from the hydrazine preparing & dosing room, ammonia preparing & dosing room

Technical solution:

Fixed or movable hoods located in the hydrazine and ammonia preparing & dosing places. Such hoods provide about 0.5m/s circulation of the air around the preparing and dosing place.



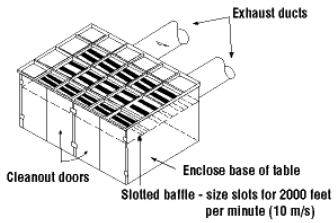
5.2 Electric Section

a)Elimination of the occupational noxes from the electric workshop during the welding operation.

Technical Solutions:

a.1. Local ventilation

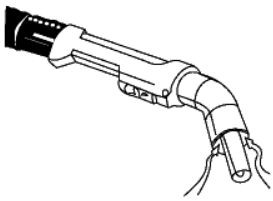
- provide a movable grate system which permits the closing and opening of the workspace, the system being constructed so that the speed of the air flow should be sufficiently high to assure the efficient removal of the occupational noxes from the workplaces (especially for welding).



a.2. Mobile (flexible) hoods located in the place where welding operation is performed; such hoods provide a rate 0.5m/s for the circulation of the air around the place where the welding operation takes place.

a.3. Special systems for fumes extraction

These systems exhaust the extraction into an external system. They are very expensive, however they are very efficient for the vertical surfaces and for the corners of the welding execution surfaces.



b) Elimination of the occupational noxes from the electric repair workshop during the unwinding of the small motor parts, degreasing of small parts with trichlorethylene, reconditioning of the motors

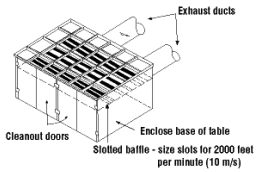
Technical solution:

b.1. Make, within the Electric station, separate ventilated enclosures where there can be performed: the unwinding of the small motor parts, degreasing of small parts with trichloroethylene, reconditioning of the motors.

c) Elimination of the occupational noxes from the battery chargers station

Technical solution:

c.1. Provide a better local ventilation by the help of a mobile grate system which permits the closing and opening of the workspace, constructed so that the speed of the air flow should be sufficiently high to assure the efficient exhaustion of the occupational noxes from the workplaces (especially for welding).



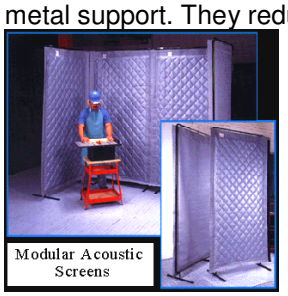
5.3 Boilers & Fuel-fuel oil Sections

a. Elimination of the noise
Technical Solution:
a.1. Noise absorption systems:

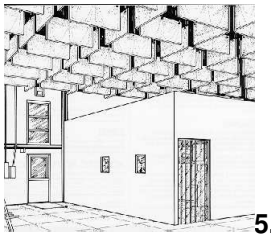
1. AFSC-122 System – based on fibreglass material. It is used to efficiently protection wrap the pipes. It is covered with a vinyl-protecting layer resistant to oil, water and dust.

2. AFNE-122 System – is a combined noise absorption and diffusion blocking system. It is made from a material based on fibreglass wrapped in a vinyl foil and fixed on a metal support. It is a protection system to be constructed around the source of noise. It reduces the noise up 12-15 dB.

3. Modular Acoustic Systems – portable, easy to be moved and handled. They are fixed on steel rails by the help of some rubber wheels, which permit an easy motion of the noise absorbent panels. The panels are made from a material based on fibreglass, wrapped in a vinyl foil, fixed on a metal support. They reduce the noise up to 6-12 dB.

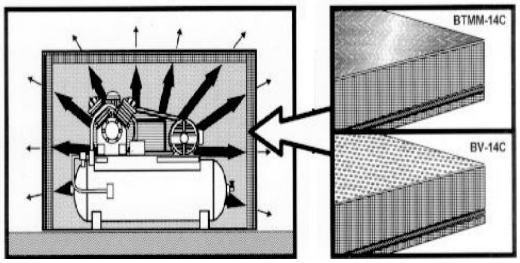


4. Noise Absorbing Screens – made of porous materials: fibreglass, mineral wool, sponge rubber, wooden wool, synthetirized metal. The screens are built in the ceiling and they absorb both high and low frequency noises. The absorbing screens can reduce the noise with up to 10 dB.



5. System for pump noise attenuation – system for pump embedding. The

embedding material is made from metal or vinyl. It reduces the noise between 20 – 40 dB.



The following technical solutions are suggested for the Fuel Section:

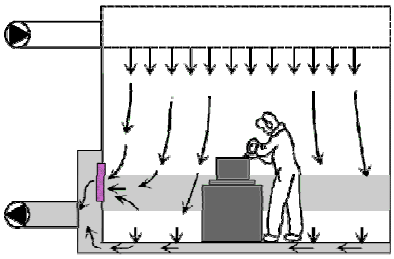
- the most efficient solution aims at combating the scattering of the powders in the powder generation places (encapsulation of the powder generating equipment and diminution of the air pressure inside it);
- dilution of the powder concentrations via ventilation in the workplaces.

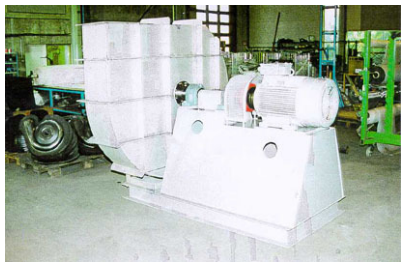
Solutions are suggested via ventilation:

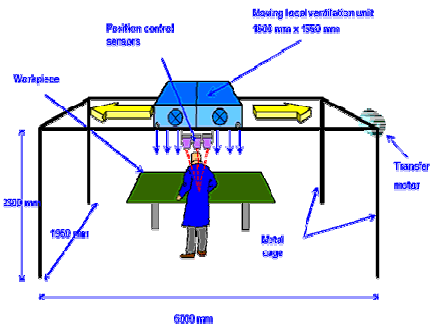
- introduction of the conditioned air
- general exhaust
- local exhaust
- natural ventilation
- fresh air caption and introduction instead of the exhausted polluted one

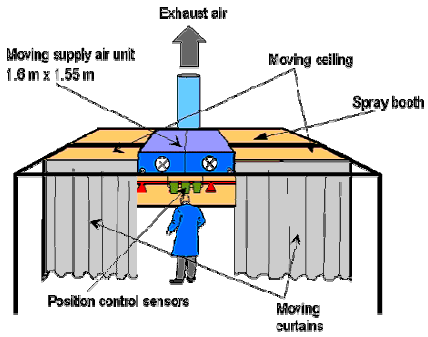
- air humidifying. Through the conglomeration of dust particles, their weight increases, facilitating thus the falling down on the soil
- maintain continuous cleanness through the caption of the powders from the soil by the help of a mobile vacuum cleaner.

Examples of local ventilation:









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