

ABOUT ECOLOGICAL SOLUTIONS AND TECHNOLOGIES USED ON CONSTRUCTION SITE

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Abstract: *The paper contains a reliance on scientific and technical bases of the methods, processes, technologies and equipments for prediction, prevention, protection, intervention and natural and antropic risk reduction required on construction sites so that it becomes ecological. Each construction site has its specific conditions which must be considered when we evaluate the effects of environmental media (air, water, and soil). The impact of all activities developed at construction site is both on the environment and on the human communities who live in the surrounding area. In consequence, there are the multiple solutions in order to avoid or reduce its impact on the environment. In this paper, the author presented sustainable solutions based on the efficient and ecological technologies that are used on the construction site.*

Keywords: *site, ecological technologies, protection, environmental*

1. Introduction

Nowadays, the protection of natural resources is the fundamental desiderates of construction. In this field, major impacts on environment they have the specific activities regarding to conception, manufacturing of construction materials, transport and putting into practice, exploitation and maintenance, demolition and material recycling etc.

In Europe there are specific regulations about limits of noise level on the construction site, such as [2]:

- in the case of technologic processes which generating noise, such as demolition waste concrete/brick, loading – discharge materials, drilling piles, maximum noise level allowed is $L_{eq} = 83 - 92 \text{ dB(A)}$;
- in the case of road activities the main operations which consist on scraping, asphalt milling, cleaning scraps at concrete road, using asphalt millings, hammers, skid-loaders, excavators, pavers asphalt mixture, compactors, the noise level must not exceed $L_{eq} = 85 - 90 \text{ dB(A)}$;
- in the drilling case the noise level must be until $L_{eq} = 78 - 85 \text{ dB(A)}$.

Vibrations into ground generated by construction sources can be roughly divided into two categories: transient and steady-state

vibrations. For both possibilities to vibration transmission, in engineering practice, evaluating of the safe construction distance to adjacent building structures presents major importance.

If construction work is placed in the urban area, near residential environment, it is necessary to take into account the environmental pollution factors: vibrations, noise, air emissions, dust, etc.

All construction sites generate high level of dust (consist in cement, wood, stone etc.) which can be carry to a large distance over a long period of time.

The ecological measures shall be incorporated into any construction project in economical manner.

The images from fig.1 present some particular activities generating noise, vibrations, air emissions and dust.

a)





Figure 1: Air pollution during work activities with technological equipments
a) drilling machine; b) crusher;
c) hydraulic hammer for demolition.

Environmental management is regarded an approach to ensure that all appropriate legislation is complied with and the environmental impact of a development is minimized.

2 Management on the constructions site

Management of the site consists of the following activities:

- ensuring the execution of the works to a high level of quality and competitiveness;
- implementation of new technologies and equipment working to exploit advanced technology and superior economic resources as raw materials and energy;
- planning, organizing and controlling activities of a technological process so that the work be as better made;
- putting into practice of appropriate scientific theories, quality control, resource management, mechanization and automation processes;
- assuring of the correct maintenance of heavy machines for minimizing of the smoke in the exhaust emissions and prevention of the contamination of ground and water sources by accidental spillages of oil and fuel;
- using of dedicated technologies for materials recycling.

The pre-construction management includes a few steps of site investigations, such as:

- inspection of buildings conditions from adjacent area;
- implementation of a policy of buying/ renting the technological equipment which have low level of noise and emissions. Acquisition the new equipment which is much quieter and ecological;
- planning of work so that workers' exposure to noise to be minimized;
- implementing a management plan to combat noise through planning, training, site organization, site configuration, equipment maintenance activities etc.

The post – construction management on the site contains a lot of actions, such as:

- noisy sources must be sited at safety distance from workers and by antropic area;
- mounting the temporary barriers/ enclosures around noisy equipment for significantly reduce noise levels, e.g. plywood with sound absorbing materials;
- implementation of work programs which control the noise exposure;
- organizing work so that the time spent in noisy areas to be limited;
- limiting the area which needed excavation, grading, demolition activities;
- minimizing the amount of excavated material or waste materials stored at site;
- establishing speed limits so that vehicles which running on site shall displacement at a speed that minimizes dust emissions (<15 miles per hour);
- loading trucks carrying material so that this does not extend above the walls.

The management decisions on work activities on construction site consist, with priority, in decreasing the workers exposures to noise, through:

- displacement workers away from the noise source;
- restricting access to noisy areas;
- rotating workers performing noisy tasks;
- stopping noisy equipment when the working activity is finished.

The level of exposure to noise can be more effectively reduced by incorporating preventive measures into the design of workstations and workplaces and by selecting of working equipments, procedures and methods so as to give priority to reducing the risks at source. Against noise, many measures can be implemented in the following phases: planning, organizing, contracting and construction. Vibrations transmitted to hand-

arm operator appear to use of equipment such as pneumatic or hydraulic hammers, drills, compactors, vibratory plates etc. Directive 2002/44/EC requires the employers to reduce worker's exposure to hand-arm vibration [1]:

- daily exposure action value $A(8)_{2,5}$, standardized to an 8-hour working period, is 2.5 m/s^2 ;
- daily exposure limit value $A(8)_5$, standardized to an 8-hour working period, is 5 m/s^2 .

Personal protective equipment (PPE) must be given to protect the workers against the risks on construction sites. The most common types of PPE are presented on the fig.2.



Figure 2: PPE – examples

3 Modern concepts of reducing environmental impact construction work

We can identify these essential steps in implementing construction works with low environmental impact by:

- selection of appropriate technological resources necessary to accomplish the construction work;
- choosing an ecological technology with adequate equipments;
- using of sustainable methodology for environmental impact assessment on site.

In our days, ecological materials were gained an important place even in the machinery industry. The use of petrol and fossil fuels by heavy equipments directly contribute to atmospheric pollution. There are new solutions which were implemented by manufacturers (e.g. Komatsu, Hitachi, Volvo, Caterpillar, etc.) which consist on the very low pollutant engines, so called next-generation engines (which realizes fuel efficiency and reduction in CO2 emissions), or components (body, board, commands, accessories, etc.) from ecological materials in order to reduce its impact on the environment.

Developing of the earth moving machines in accordance with the environmental regulations, based on “environment”, “safety” and „IT” concepts leads:

- compliance with next-tier exhausted gas regulations;

- adoption of integrated control of the engine and hydraulic power for increased of work efficiency;
- low level for vibrations and noise submitted to operator and environment.

Available equipments and technologies that can be use for cleaner operations on the site will be described below.

In the case of aggregates processing can select the bucket-crushing equipment (fig.3) for to realize the work in situ, on the construction site.



Figure 3: Bucket-crusher equipment

Thus, it obtains the substantial decreasing of the number of equipments for aggregates processing, fuel economy and environmental pollutants removed, the manpower, time processing of natural aggregates, etc.

The equipment shown in fig.4 represents the state-of-art technologies for hot asphalt recycling in situ, from point of view of the technical innovations with implications on the cost efficiency and environmental aspects (without emitting pollutants into the atmosphere). Thus, it is inadequate to spread the mixture with shovel, or wheelbarrow or directly from the dumper, except for works on very small or limited access areas.



Figure 4: Ecological equipments for asphalt recycling

A present trend that must be taken into account in the choice of equipment for the execution of road works consists of selection of the modern machinery for milling with the next component parts:

- conveyor belts covered (Fig.5), eliminating the milled material in wheelbarrows loaded with shovels shrinking the material losses and air pollution by dust entrained air currents;

- ecological milling humidification system dust, greatly decreasing its quantity discharged in the environment.



Figure 5: Cold recycler equipment with vacuum cutting system (Wirtgen Inc.)

There are various methods to reduce dust on construction, as can be seen in the fig.6 [3]. Some usual solutions such as water spray (fig.6a) or water tanker with spray heads at the back (fig.6b) are shown below.



Figure 6: Dust control measure on site
a) water spray; b) water tanker with spray.

A new generation of pneumatic hammers (e.g. TEX PE - Atlas Copco) assure highly efficient silencing and vibration dampening systems which prevent up to 75% of the vibrations from reaching the operator and the integrated silencer cuts noise emissions up to 50%. Hereby, it is more comfortable to use with them over prolonged periods with effect on increased individual productivity.

3 Conclusions

As regarding remarks we can say that it is necessary to make a change regarding the global approach to processes involved in construction field taking into account by the ecological technologies that are available nowadays.

In addition, implementing of the site control measures in each stage of construction development can reduce the environmental impacts

and reduce the nuisance levels to the surrounding areas in the case of construction site.

4 References

- [1] *** Directive 2002/44/CE concernant les prescriptions minimales de sécurité et de santé relatives à l'exposition des travailleurs aux risques dus aux agents physiques (vibrations).
- [2] *** Directive 2002/49/CE relating to the assessment and management of environmental noise.
- [3] *** No Dust. Guidelines for controlling dust from construction sites. EPA. 2006