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Reducing dangerous waste by applying low-waste technologies

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ABSTRACT

Purpose: Growing level of automatism, information technologies and other technological achievements on the one hand and unadjusted production companies in Bosnia and Herzegovina on the other, impose a need for new knowledge from the aspect of adaptability and increasing eco-efficiency of production systems. Engineers face the problems of growing trends of change in the area of technology, organization, decision making process and management of production systems. Changes cause searching for new solutions, and solutions demand innovative action in changed conditions. New and innovated technologies, also wide appliance of recycle procedures of waste materials and their further use, will lead to appliance of new production principle "production-consumer-waste-recycle-entrance", which demands a need for new knowledge connected with relationship between production system and environment. For production systems, strategy of Cleaner Production is primarily applied to reducing pressure during whole cycle of production and services, from design and use to the final disposal.
Design/methodology/approach: This work will show how dangerous and toxic waste can be controlled and reduced by using principles of "Cleaner Production", as well as how that task will be transferred to the lower level of managers, who should predict, plan, manage and control the market. Using control of quantity and quality of raw materials, parameters of workability and reduction of waste risk materials can be influenced. The factory producing tools planned and carried out an experiment with the purpose of substitution of the mineral oils for cutting. That experiment has been carried out by the mathematic apparatus „Box-Wilson" with the usage of two-factor plan of the experiment.
Findings: Experiment showed that it is possible to use synthetic oils for cutting in certain intervals of work. Synthetic oils are biodegradable thus they have lesser pressure to the environment.
Research limitations/implications: This work justifies possibilities of innovative action in the EMS functioning. Technologist can make plans, with permanent goal of achieving higher eco-efficiency only in the conditions of use that have been already explored.
Practical implications: There are implications with the need of researching conditions, and with processing of increased demands for the quality. Every problem needs to be approached in a experimental way and confirm the assumption.
Originality/value: This work is original in observed conditions of usage and with the usage of given approach in the research. It is confirmed that that synthetic oils for cuttings can be substituted by mineral oils and in that way increase eco-efficiency.
Keywords: QMS; EMS; Environmental Performances; Reengineering; Synthetic oils; Production processes; Drilling processes

1. Introduction

For machining processes it is necessary to implement requirements of Quality Management System (QMS) and Environmental Management System (EMS). QMS needs for being continued the analyzed measurable parameters, their comparing during production processes and, if it is necessary, their correction to satisfy consumers' and fulfil standard operative procedures. EMS needs reengineering of production processes to assure correct input data parameters on the specific working places where machining process is organized. There are more requests which are in front of products with intention to satisfy next functions as: physical quality, machining quality, assurance of its function, service, price, design, etc. The aim is successful post-life cycles control.

Environmental friendly production as a part of completed production processes is condition no 1 to show us as a serious economic partner. Partnership is precondition for survival of factory especially when we must answer the requisitions in restitution processes. For good technologists it is important to give "new solutions" as answer for "new request". Technologists are the ones who carry production changes and there are many questions in front of them.

2. From postulates of development to the improvement

When we talk about development we must think about modern factors of development and what the development factors are? There are the postulates in the market functioning - the only one judge of validity of realization of development projects. Market is personification of consumer which attributes the leading to the improvement in production processes. It is manifested through the completed its quality and environmental management systems to the TQM, with unavoidable reengineering processes. The reengineering and quality are postulates of modern development, so we can say that basic elements of sustainable development are:

- requirements of the ISO 9000/2000 standards;
- requirements of the ISO 14000 standards;
- quality to the level of TQM;
- reengineering and design of all the management processes as a function of TQM;
- improvement as a function of consumer's satisfaction;
- validation to the self-evaluation.

Requirements of the ISO 9000/2000 standards

The requirements of the ISO 9000/2000 standard define base and process model with the tight relation between consumer's request and his satisfaction through the four modules:

- responsibility of top management;
- correct resource management;
- products realization and;
- measuring, analyses and promotion.

Requirements of the ISO 14000 standards

The requirements of the ISO 14000 standard are connected with:

- fulfilment of all the requirements for environmental protection;
- achievement of more electivity for environmental protection;
- validation of their activities, operations and services.

Quality of the TQM level

One of the possible used definition of Total Quality Management is "TQM is management approach to the continually improvement of processes in the organization which are realized on the basis defined strategy, vision and mission directed to fulfil satisfaction of consumer, with the goal of achievement of world class quality of products and services".

Complex definition of the TQM is directed to the key words: leadership of top management, product improvement, world class of quality. Performances of system with confirmation of producers improvement (that's mean leadership at all levels of management, continual education of employees, improvement of production processes, flexibility in the aspect of the request of environment and interesting groups, efficiency to the market requirements, design and disposal of goods) show us that we can reach TQM using reengineering. That's mean the consumer takes the central place in that mosaic and form (TQM, reengineering, product improvement) as a promoter, assessor and user. There are four limited working levels toward the reach, maintain and improvement of TQM:

- doing the jobs;
- improving the jobs;
- improving the improvement of jobs;
- improving the improve of improvement of jobs.

Reengineering is a project of business organization which goal is to improve significant characteristics of main processes using simple opportunities to accomplish exception of consumers. Process is a flow of jobs in addition of validity that enables transforming whish of consumer as input to the real value as output. That value is changing (from "+" to "–") through the many of functions of business organization.

Reengineering of management as a function of TQM

At the last time it appeared the necessity to define best way of organization of management. Field of action is between two extreme variants of organizing the management: classic type or hierarchy and network type or team approach. Hierarchy and network type are characterised by significant differences, and using one or the other type in various business organization can be found as successful or unsuccessful. Specific point of it is that in any variant, even and in the transition variants manager doesn't loose his position but he changes his managing of business organization. According to mentioned above, management stopped to be effectively giving tasks to lower level in the business organizations. That's mean the manager must be opened for new ideas, suggestions and initiatives of his colleagues.

Eco-management as modern approach for environmental management

Eco-management could be defined as a part of EMS which should help industry in order to systematically organize approach to the environment and to build it's concern about environment in it's own production and business strategy. This definition does not

mean only control of pollutant emissions of waste material or waste management, it is more sophisticated concept which represents the answer on crucial question: how could we find optimum between production and environment? That means that we must take care of each phase of production processes on environmental characteristics products and production processes and packing of products, transportation activities and other effects of products to the environment. Developed country industry is under the permanent pressure to improve environmental efficiency of production processes, distributions and services and its ecological characteristics. There are many influences of different factors toward these requisitions for industry and some of this are:

- implementation of market directed instruments into the environmental law and in connection with that - very strict standards. Market subjects should change its behaviour in accordance with principle "polluter pays". It means that using the natural resources and pollution of it will cost and must be calculated as one of production cost;
- it is evident interest of customer which is well educated and takes the tension on the ecological cleaner products. On the other side company that produces and sales "eco friendly" products is very successful because of it.

Environmental management policy is defined at the international level by the international agreements and conventions. Accepting a principles, instruments and standards is one of the key that prerequisites for our approaching processes to the develop countries. Harmonizing our standards with the EU standards is crucial for Bosnia and Herzegovina. If we don't accept EMS as a part of company strategy and business opportunity it could influent significantly bad to our manage affairs.

3. Practical example

Bosnia and Herzegovina has a good metal industry companies. With the excellent human resources, images and tendencies in the development opportunities it has good chances to reconstruct and continue cooperation with the European and world companies.

Tools industry Trebinje, from SE part of Bosnia and Herzegovina is one of it, with the 50 year tradition in tools production. That part of B&H is rich with the clean water resources and it is suitable for agriculture and eco tourism. Tools industry uses about 60 tons of heavy biodegradable cooling and lubrication oil for machining processes per year, and 1/3 of it disperses out of system on the different uncontrolled ways:

- burning and evaporating;
- with the chip;
- with the products;
- technical incorrectness of equipment.

Finding better solution for this problem is a necessity. This practical example is talking about one solution for this problem by using synthetic easy biodegradable oils, which are friendly for environment. Old oils are unacceptable for environment management system and it couldn't satisfy the requirements of ISO 14041 standard.

Research were conducted in the two series of experiments: with the old classic lubricant oil (heavy biodegradable oil) and with the new synthetic lubricant oil (easy biodegradable oil) in conditions of drilling two different materials (aluminum alloy and steel with characteristics showed in the Table 2 and 3). Mathematic modelling of drilling processes was calculated by Bocks – Wilsons multifactor analyses of first row. Numerical dependences between quality parameters processes metal and drilling processes for Al-alloy and steel was calculated by the equitation:

$$R_a = C \bullet v^x \bullet s^y \ (\mu m) \qquad (1)$$

R_a – average deviation of roughness,
C – constant depending on material,
v – drilling speed (m/min),
s – feed (mm/revolution),
x, y – exponents depending on condition of machining process.

Parameters of the process were:

- area of drilling speed variation (Al alloy):
  v_{min}=60 [m/min]; v_{max}= 90 [m/min],
- area of feed variation (Al alloy):
  s_{min}= 0,09 [mm/o]; s_{max}= 0,20 [mm/o],
- area of drilling speed variation (steel):
  v_{min}= 20 [m/min]; v_{max}= 30 [m/min],
- area of feed variation (steel):
  s_{min}= 0,04 [mm/o], s_{max}= 0,12 [mm/o]

Chosen cutting edge in type N with characteristics has been shown in the Table 1.

Table 1.
Standard characteristics of cutting edge

γ	α	φ	ψ	S	t		Δs	e_1	d	Δd	p_1	p_2	z	l	l_1
27°	12°	128°	50°	1.5	0.25	0.19	0.60	0.03	8.0	0.02	4.28	4.31	4.5	116.5	77

Table 2.
Chemical composition of Al alloy (AlMgSi) (%)

Mg	Fe	Si	Ti	Cu	Zn	V	Cr	Mn	Pb
2.10	0.27	0.30	0.045	3.5	0.04	0.005	0.001	0.83	0.15

Table 3.
Chemical composition of steel (C.1530) (%)

C	Si	Mn	P	S	Cu	Cr	Ni	Mo	Pb
0.46	0.18	0.52	0.03	0.04	0.29	0.32	0.12	0.02	0.15

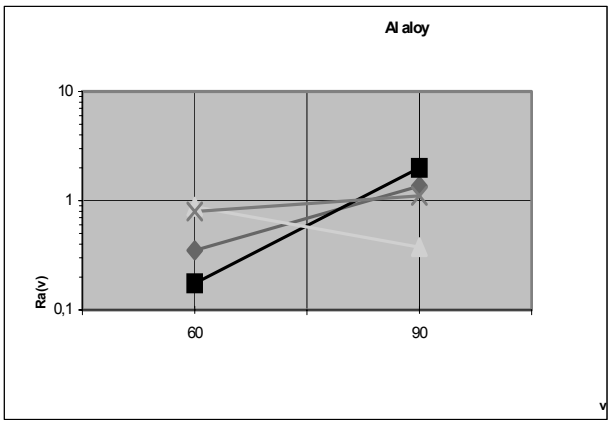

Fig. 1. Diagram Ra(v)-speed

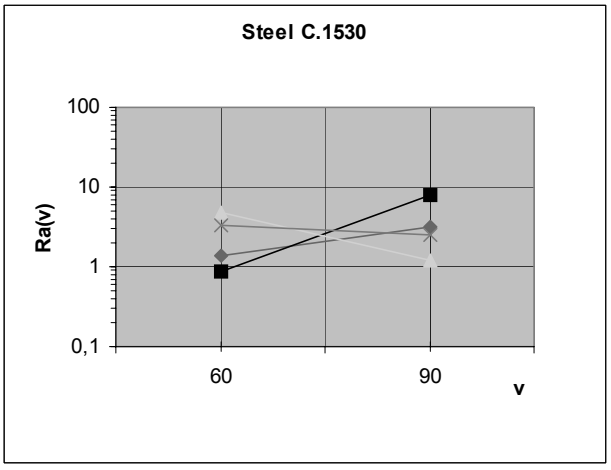

Fig. 2. Diagram Ra(v)-speed

Legend for Figs. 1 and 2.

- ♦ Synthetic biodegradable oil ISO VG 15
- ■ Mineral oil ISO VG-22
- ▲ Semi synthetic oil ISO 3170 (5% emulsion)
- × Synthetic oil ISO 3170 (7% emulsion)

The experiment has been carried out at the drilling machine type ASIERA PA22. Quality parameters of metal processes have been measured at PERTHOMETER S6P by using one-axis indicator. Results of research and calculation have shown at diagrams (Figs. 1, 2.). Analysis of results and diagrams are given partially in next part.

4. Conclusions

In this paper we tried to give contribution to the methodological approach for searching systematic answer from the company and concerning Quality Management System and Environmental Management System.

After the experiment, that has been carried out, we can conclude that using synthetic oil for drilling processes is satisfied for quality of metal surface and for removing chip. Parameters of workability with synthetic oils give similar results as in the case of mineral oils usage, so it is possible to conduct research in the field of their permanent substitution. It is important to have a good cooperation between oil producers and company especially in the testing phase of lubricants which can give good oil layer in condition of higher pressure and temperature.

Taking care about QMS and EMS, producers of synthetic oil and consumer become strategic partners in the machining processes.

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