Journal of Applied Sciences 4 (2): 197-200, 2004
ISSN 1607-8926

Effective Methods Analysis for Machines Noise Control

[1]Mohammed A. Alnawafleh and [2]O.N.Nizhibitsky
[1]Mechanical Engineering Department,
Tafila Applied University College, Al-Balqa' Applied University,
[2]Materials Processing Department,
St.Perterburg State University of Tochnology and Desingn, Petersburg

Abstract: Damping of mechanical vibrations of thin-walled elements is simultaneously associated with suppression of vibrations in the source and on their spreading ways of air or structural noise. Nevertheless, the real source of vibrations is the activator of plate vibrations. The absorption of structures thin-walled elements vibrations (air pipes, thin metal disks) can be done by classical method by connecting the vibrating surface of mass with springy-viscous elements. In other cases various methods of noise control and damping materials are applicable.

Key words: Damping, mechanical vibrations, air structural noise, vibrations of plates

INTRODUCTION

The global experience of application of various noise control means gives consolatory results[1,2]. Simple means of noise control are possible[3-5]. For air pipes more often are used damping mastics and coverings whereas, for thin-walled machine protection, laminated damping coverings with mastic filling are applicable on the other hand, for thin rotating disks, tightened damping washers and also electromagnetic or pneumatic damping overlays are used. Effect is up to 13 dB. Therefore, machine protections facing by mastics and PVC allows to decrease the drive noise in all sound frequencies range by 4-8 dB. Facing the basic noise radiating sources of a lathe (basic casing details, frame, gear box, drive) by damping mastic and protection allow to decrease the sound pressure level by 2-6 dB and the sound level by 3 dB. Facing the body of any machine by damping mastic provides the reduction of high-frequency noise by 4-6 dB.

Analysis of the basic aspects of a noise control problem: To analyse some of the most typical noisy objects of various branches and machine tools, let us consider processes of noise generation in metal or wood processing machine tools. The mechanisms of machine tools are divided into three groups: mechanisms of drive and stop motion, working mechanisms and mechanisms of the technological process control and automation.

The vibrations of frame on machine tools of all types include as low-frequency vibration, multiple of disturbance basic frequency, as high-frequency vibrations, multiple of own frequencies of structure elements of the machine tool, including vibrations of secondary character radiated by thin-walled elements, protection and others. Machine tools are partially or completely protected by meeting the requirements of safety precautions and design.

For a given problem, many researches were conducted for analysis of the complex character of noise arise[5,6]. The basic generators of acoustic fields are the mechanisms: cams, lever, gears, ball and roll bearings and others. It is possible to determine the appropriate hierarchy of noise sources by the spectrum and intensity of radiation. So, the high-frequency noise of the majority of machines is generated by shock excitation in the mechanism parts and working motions by impulses with duration of 5 up to 0,08 msec. In a number of mechanisms the noise generation by friction is noted as auto oscillatory process. The noise of rotation sources is distinguished. The source of intensive mechanical noise is always the unbalance of the mechanism rotating parts.

The shock noise arises in mechanisms of shock action are: in detail joints with a gap; in toothed gears for power transmission; in bearing supports of the main shaft and the power selection shaft, etc. At a friction of contacting surfaces in bearings, gear transmission, relaxation processes are arisen by friction forces[7,8].

Corresponding Author: Dr. Mohammad Al-Nawafleh, Mechanical Engineering Department, Tafila Applied University College, Al-Balqa Applied University, P.O.Box: 179(66110) Tafila-Jordan,
Tel: 00962 3 2250326 Fax: 00962 3 2250033

Effective methods analysis for noise control: The problem of industrial noise has many aspects (Fig. 1). However, two aspects are distinguished: science-technical and social-economic. Let us consider in more details the effect that can be achieved by various noise control methods.

Pneumatic damping provides not only highly effective suppression, but also excludes mechanical contact and cools rotating details, for example the circular saws. The application of hydrodynamic dampers is possible, which can be attributed to the category of shock absorbers. Absorbing of massive solid vibrations is achieved by changing the structural properties of this solid. Effect of the special dampers usage is 6-10 dB. The reduction of secondary sources noise level at sound absorption in the area of a diffusion field can reach 12 dBA. The broadband sound absorption is attached by walls covering of an industrial premise, vent chambers or air pipes by porous materials. The narrow-band resonant sound absorption can ensure acoustic effect up to 50 dB in a spectrum. Vibroinsulation in practice is used in cases, when it is necessary to reduce the level of vibrations or noise, which are transmitted from the source to the human organs. Various types of vibroinsulating shock absorbers are applied: mechanical; dynamic; electromagnetic and others. The large variety vibroinsulating appliances give ample opportunities to decrease industrial equipment noise and vibrations. Being combined with a damping the cumulative acoustic effect can attain 10-15 dB (Fig. 2, 4).

Damping of certain machines vibrations (processing fibbers, plastics and rubber) allows decreasing noise by 2-3 dB and in some cases even by 6 dB. Besides, vibroinsulating of rotors and discs reduces vibration of the machine body and its particular details[9-10].

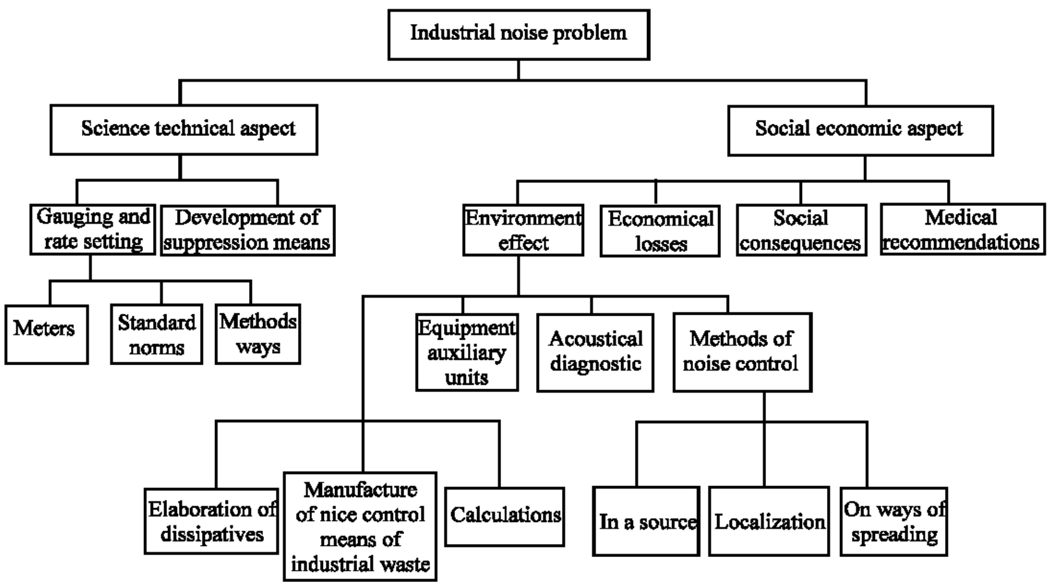

Fig. 1: Core aspects of industrial noise problem

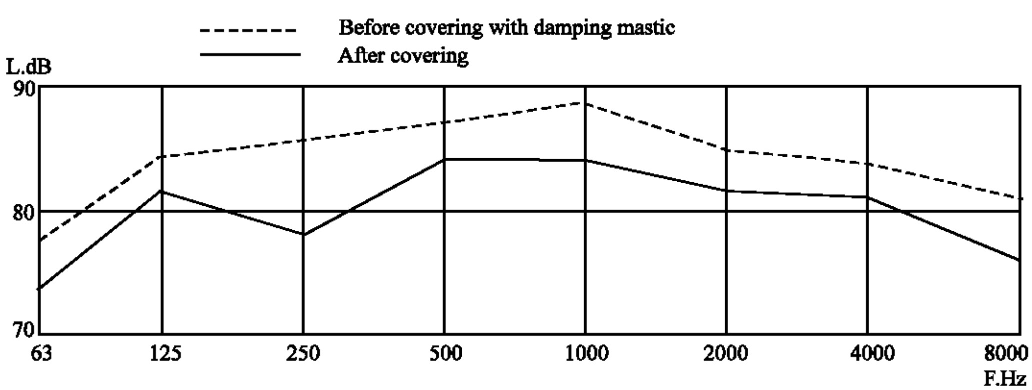

Fig. 2: Spectra of the lathe sound pressure

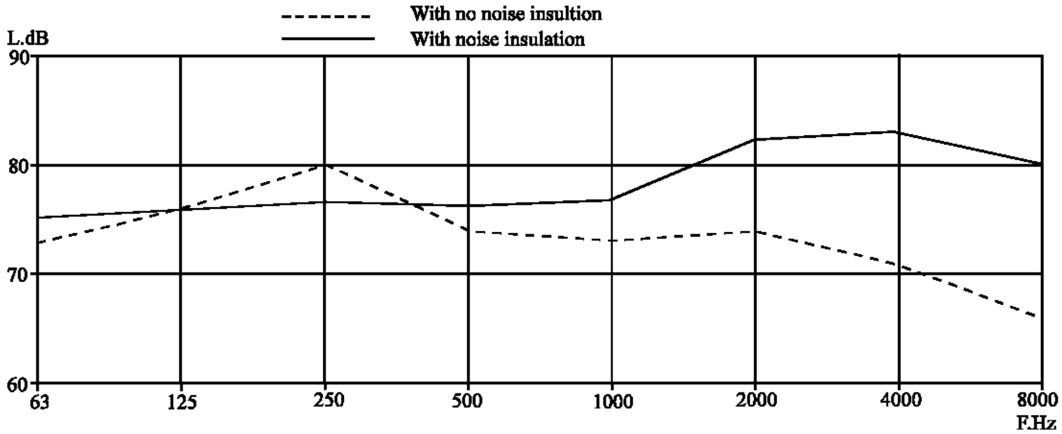

Fig. 3: Spectra of the same lathe sound pressure

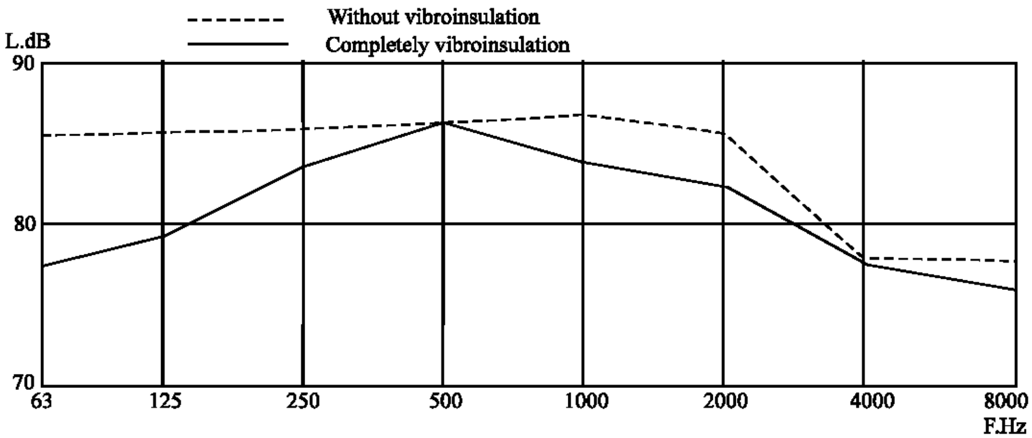

Fig. 4: Octave spectra of the same lathe sound pressure

The most widespread and effective method to decrease the noise on its spreading ways is sound insulation, which does not require an intervention in the machine structure. The acoustic effect can attain 25 dB under condition of utmost hermetic sealing, inserting sound absorber or damping in the casing walls.

The local sound insulation with partial hermetic sealing creates effect of acoustic screening. As the sound isolating screen the sliding shutters made of methylmetacry late by 4mm thickness can serve and will allow to decrease the lathe noise. Sound insulation of a drive, which was made as a steel casing covered inside with a sorbent, has allowed reduction of high-frequency noise by 7-13 dB (Fig. 2).

In some cases the method of vibrations spatial additions is applied. The interferential mufflers are used, for example, in systems of ventilation. The use of spectral masking method is possible, for example, high-frequency vibrations by low-frequency ones.

In practice the method of spatial vibrations is seldom used, when the signals are given out of phase. A passive method of noise protection is the application of individual protection means, which after long use reduce an acoustical threshold and worsen auditory-orientation of a man in a space.

As a whole, the ample arsenal of noise control means requires special analysis by way of social economic expediency, especially, in conditions of a market. Searches of alternative economic solutions in this connection are urgent, by way of selection of cheap and not scarce raw material and also simple energy saving technologies.

REFERENCES

1. Smith, B.J., 1996. Acoustics and noise control, London, Addison-Wesley, 2nd Ed.
2. Crocker, M.J., 1998. Handbook of acoustics, New York, Wiley.
3. Lothar, Cremer and Helmut, A. Muller, 1982. Die wissenschaftlichen Grundlagen der Raumakustik. Principles and applications of room acoustics, translated by Theodore J. Schults, London, Applied Science.

4. Kuttruff, Heinrich. 2000. Room acoustics, London, Spon, 4th Ed.
5. Fahy, F.J., 2001. Foundations of engineering acoustics, San Diego, Calif, London, Academic.
6. Turner, J.D. and A.J. Pretlove, 1991. Acoustics for engineers, Houndmills, Basingstoke, Hampshire: Macmillan.
7. Stewart, N.D., 1977. Spinning Noise. Textile Industries, 141: 29-34.
8. Kluva, 1979. Handbook in Industrial Noise Control. Machine Building Publishers, Moscow, pp: 447.
9. Kheklenga, P., 1980. Aerhydromechanical Noises in Machinery, Meer Publishing House, Moscow, pp: 336.
10. Creetescii, I.E. and E.V. Kornev, 1974. Vibration and Noise in Textile Industry, Light Industry, Santpetersberg, pp: 327.