

A.Yu. Kharlamov

## RESULTS OF EXPERIMENTAL INVESTIGATIONS FOR ACOUSTIC PARAMETERS OF AIR FLOW OF VACUUM-BLOWING MACHINE

Voronezh State University of Architecture and Civil Engineering  
 Russia, 394006 Voronezh, 20-Letiya Oktyabrya Street, 84  
 Ph.: (0732) 715-918; the fax: (0732) 715-905  
 E-mail: ust@VGASA.VORONEZH.SU

The possibility of reducing acoustic effect of air flow on an operator is considered. As a result of field tests of vacuum-blowing machine, Model B68M-250 there has been revealed the reduction of sound pressure level (SPL) due to the change of nozzle design. In this case the speed of air flow insignificantly declines from the rated value. The dependences of the air flow speed and the SPL of the angle of the nozzle bevel are given.

The application of machines for cleaning concrete and asphalt-concrete pavements of large areas from sand, concrete chips, stones and other foreign items gives rise to the problem of acoustic environmental contamination. So, provision has to be made for reducing noise including application of probes on the nozzle with different inclinations.

A vacuum-blowing machine, Model B68M-250 is designed on the KrAS-250 truck base. Operating members of the machine are an intake device for suction of foreign matters from the surface being cleaned and a nozzle for blowing off foreign items by kinetic energy of air flow.

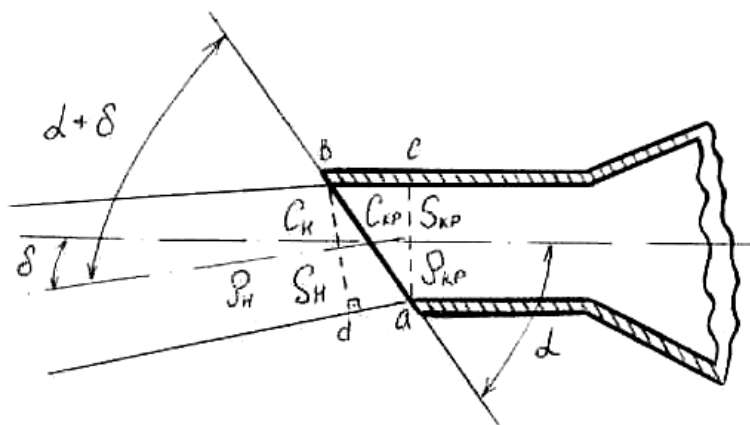
One of the main sources of the acoustic energy in the vacuum-blowing machine is noise of turbulent flow emanating from a nozzle.

The investigations have been conducted with the aim of defining the air flow speed and the sound pressure level at different inclinations of the nozzle probes. The main task is to find an optimum inclination of the probe  $\alpha$  which results in reducing the noise level.

The angle of deviation of the jet of gas in an oblique cut  $\alpha + \delta$  may be approximately determined from the equation of continuity of the jet for sections  $S_{kp}$  ( $ac$ -section of air flow before bevelling the nozzle probe) and  $S_n$  ( $bd$ -section of air flow at the moment of its exescape from the nozzle probe):

$$S_n C_n / \rho_n = S_{kp} C_{kp} / \rho_{kp}, \quad (1)$$

where,  $C_{kp}, C_n$  - gas flow speed in sections  $S_{kp}$  and  $S_n$ , respectively, m/s;  
 $\rho_{kp}, \rho_n$  - the density of gas in sections  $S_{kp}$  and  $S_n$  respectively, kg/m<sup>3</sup>



**Fig.1.** Air flow on coming out of the nozzle.

Where  $\alpha$ -is the inclination of the nozzle probe;  
 $\delta$ -is the angle of deviation of the jet from the axis.

.Fig.1 gives in terms of result (1):

$$S_n = S_{kp} \sin(\alpha + \delta) / \sin \alpha \quad (2)$$

Then from equations (1) and (2) follows:

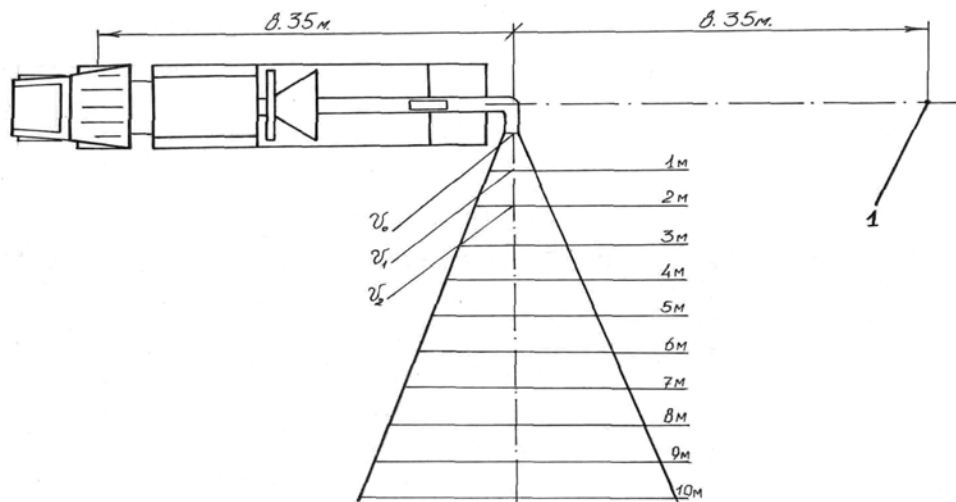
$$\sin(\alpha + \delta) = C_{kp} \rho_n \sin \alpha / (C_n \rho_{kp}) \quad (3)$$

In the course of the investigation the following problems have been solved:

- measuring devices meeting the standard requirements have been selected;
- the site for tests meeting standards requirements has been chosen;
- necessary measurements have been taken and their results have been tabulated;
- diagrams and spectrograms have been constructed.

All the experiments have been conducted on an open site in a free sound field on a solid (concrete) surface at the maximum engine speed  $n = 2,100$  rpm [1,2]. The measuring of noise has been made behind a truck at a range of 8.35 m ( it corresponds to the distance from the nozzle to the operator's working place and includes as much as possible the superimposing of noises from other sources (a basic truck engine, an engine of a special-purpose arrangement, etc). This has been performed in accordance with the requirements for the measuring conditions [3,4].

Fig. 2 . gives the scheme of conducting the experiment:



**Fig.2.** The scheme of conducting the experiment.

1 - the point of measuring noise level.

$V_0, V_1, V_2$  – the air flow speeds

The air flow speed in the range from 0 to 50 m/s has been measured by means of an anemorumbometer M-47 designed for measuring wind speed [5]. The measuring of the air flow speed in the ranges of 150 -2,000 km/h (42-555 m/s) has been made by an aviation device CSI - 2000 (combined speed indicator) together with APR (air pressure receiver) according to the principle of defining aircraft speed. The air flow speeds have been determined within 10m of the nozzle.

The noise level has been measured by the device OKTAVA 101-B. Measurements have been taken for nozzle probes with different inclinations ( $0^{\circ}, 15^{\circ}, 30^{\circ}, 45^{\circ}, 60^{\circ}$ ).

The results of measuring the air flow speeds are presented in Table 1. On the basis of the experimental data obtained, diagram for the distribution of air flow speeds (Fig.3) and a spectrogram of the air flow noise in 1/3-octave frequency bands (Fig.4.) have been constructed.

Table 1

Angle of nozzle bevel	Distance to nozzle, m										
	0	1	2	3	4	5	6	7	8	9	10
0°	111	100	83,3	69,4	61,1	30	22	18	15	13,2	10,3
15°	110	103	85,3	72	62,2	29	24	17	14	12,3	9,9
30°	109	102	86,2	70,3	60,3	31	23,3	17,1	15,2	13,5	10,5
45°	111	101	88,8	71,7	60	30,5	24	18	16	13	11
60°	108	104	84,6	68,1	61,4	32	22,4	18,2	16,4	14,2	11,1

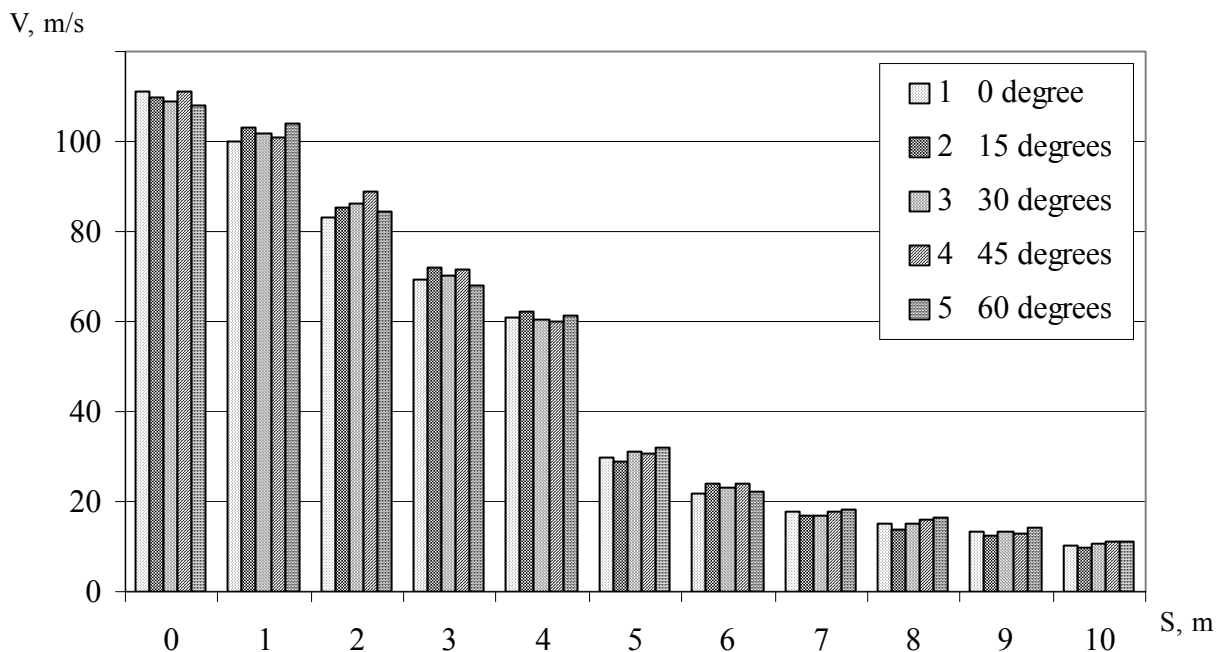
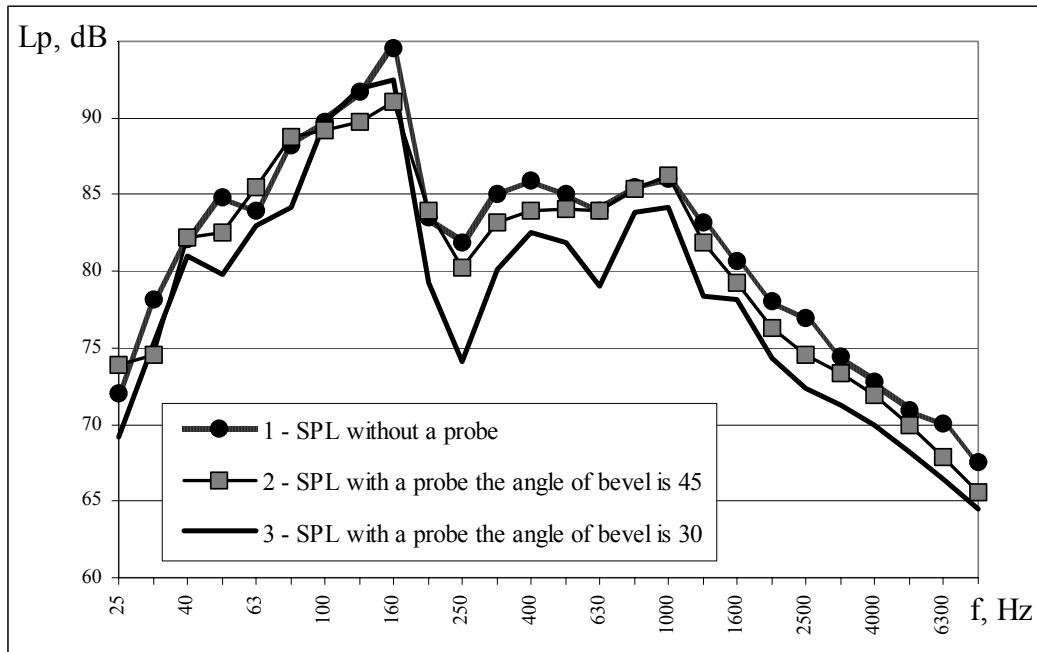


Fig.3. Diagram for distribution of air flow speeds

While analysing the data obtained when measuring the speeds of air flow we see that from 44 measurements only in 13 ones the speed is less than the rated value ( $V_{rv}$  at the angle of the nozzle bevel  $0^\circ$ ), 31 values exceed the rated value,  $\Delta_{\max} = \pm 6.8\%$ . Thus, the change of the nozzle inclination insignificantly influences the capacity of the machine. The greatest reduction of the SPL is observed with the nozzle probe having the angle of bevel  $30^\circ$  on mean-geometric frequencies of 50; 200; 250; 315; 630 and 1,250 Hz and amounts to 5.9%; 5.1%; 9.5%; 5.7%; 5.9% and 5.8%, respectively, and the general noise reduces by 2.5 dBA.



**Fig.4.** Spectrogram for air flow noise in 1/3-octave frequency bands

## REFERENCES

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