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The average metal removal rate in different placements of working chambers and different heights of working medias

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***Abstract*— The purpose of this study is to investigate the intensity of metal removal rate on vibration machining in different placements of working chamber and different heights of working media. Below tabulated and charted results show how the average metal removal varies in different placements of working chambers even if having the same volume in both vertical and horizontal placements of working chambers and shows the average metal removal in case of different heights of working medias. As indicated in the given below tables and charts the average metal removal varies in different placements (placement of width, depth and height) of the working chambers. In case of vertically placed working chambers the intensity of metal removal rate is low when we compare to horizontally placed working chambers and in case of low heights of working medias the intensity of metal removal rate is high when we compare to high heights of working. The vibration machining done on УВГ 4x10 by using working medias of porcelain bowls d 6-8 mm and for the 2nd case PT 15X15 with a regime of oscillation: A = 3 mm; f = 33 Hz; processing time for all cases are = 4 hrs; by using a processing liquid - 3% solution of soda ash. After each process we used analytical balance АД-200г to measure metal removal amount in each specimen and calculated average metal removal. Samples are duralumin D16 and steel 3. This study was conducted in Don State Technical University (DSTU) of machine building faculty in Russia.**

***Index Terms*— basic parameters of vibration; vibration processing; vibration machining; working chambers; working medium.**

I. INTRODUCTION

The concept of "vibration technology" appeared relatively in recent 60s, as a consequence of processes that used vibration exposure in engineering, construction, mining and other industries [1]. The shape and dimensions of the working chambers affect the efficiency of the process and its technological capabilities [2, 3]. In addition to the previous causes the orientation of sizes and the heights of the working media greatly affecting the efficiency of the processes in vibration work. In the works of [1, 4] concerning the improvement and design of the working chambers, it is proved that with equal volumes of vibration processing, effectiveness performance of the working chambers increased to 30 - 40 %. The reason is that with a reduced weight of the layers depth of the load (working media height), decrease in the curvature of the walls and parts of the bottoms and, therefore, decreases the degree of damping of the amplitude of vibrations. It is recommended to apply the working chambers with circular or elliptical shapes of bottom [1]. Considering the questions of the efficiency of the process and its technological capabilities, leading into account of complex phenomena, which accompanied mechanical compression of the working media. The main distinctive feature of this process is the mechanical, chemical and physical processes taking place in the local areas of dynamic contact of working medias and workpieces.

The mechanical compression of the working medias will be accompanied by the main quantitative changes in basic parameters of vibration work ($V_{w.m.}$, F, P_{max}, σ_{max}, $T°$, *etc.*). These basic parameters are largely determined the intensity of metal removal rate and processing results [5, 6].

II. MATERIALS AND METHODS

The intensity of metal removal rate tested on vibrational machine type УВГ 4x10 by taking two types of metals (steel 3sp and duralumin D16) and certain amount of samples (as indicated in each table). The intensity of metal removal rate measured after each operation by using analytical balance type АД-200г and the depth by caliper. The type of specimens and measuring device АД-200г indicated below.

a)

b)

Figure 1: a) Steel 3sp and b) Duralumin D16samples.

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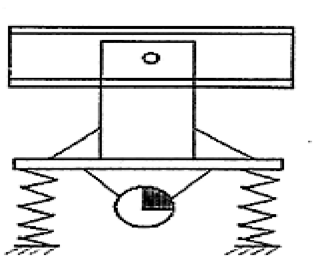
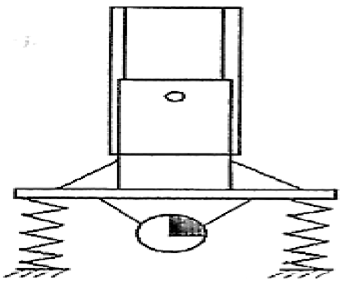
Figure 2: Analytical balance АД-200г



a) Horizontally placed working chamber



b) Vertically placed working chamber

III. Results and Discussion.

Below tabulated data's & charts shows how the intensity of metal removal rate varies in different systems of vibration machining. The vibration machining takes place by using working mediums of porcelain bowls d 6-8 mm and for the 2nd case PT 15X15 with a regime of oscillation: A = 3 mm; f = 33 Hz; processing time = 4 hrs.; by using a processing liquid - 3% solution of soda ash.

Table 1. Average metal removal in different placement of working chamber.

Operation position	Type of material	№ of samples in operation	Av. mass of samples before operations in g.	Av. mass of samples after operations in g.	Average mass of metal removal in g.
a)	St 3sp	5	2,26,560	2,26,596	0,0036
	D16	5	93,550	93,646	0,0096
b)	St 3sp	5	2,28,670	2,28,689	0,0019
	D16	5	94,840	94,867	0,0027

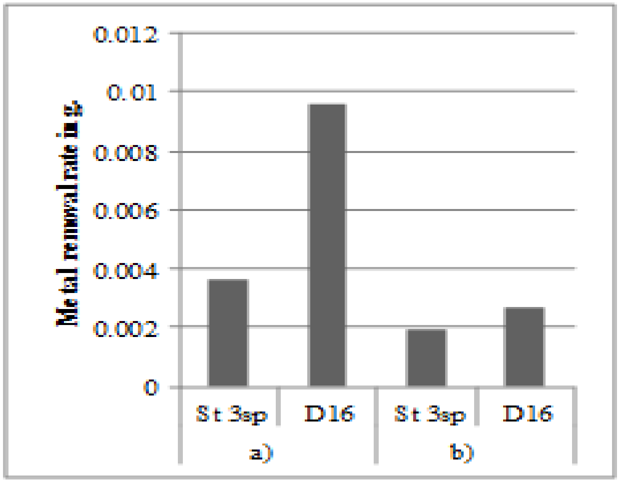


Chart 1. Average metal removal in different placements of working chambers.

Table 2. Average metal removal in 7 cm heights of working media.

Operation position	Type of material	№ of samples in operation	Av. mass of samples before operations in g.	Av. mass of samples after operations in g.	Average mass of metal removal in g.
a)	St 3sp	5	2,26,560	2,26,596	0,0036
	D16	5	93,550	93,646	0,0096
b)	St 3sp	5	2,28,670	2,28,689	0,0019
	D16	5	94,840	94,867	0,0027

Table 3. Average metal removal in 20 cm heights of working media.

Operation position	Type of material	№ of samples in operation	Av. mass of samples before operations in g.	Av. mass of samples after operations in g.	Average mass of metal removal in g.
a)	St 3sp	5	2,26,560	2,26,596	0,0036
	D16	5	93,550	93,646	0,0096
b)	St 3sp	5	2,28,670	2,28,689	0,0019
	D16	5	94,840	94,867	0,0027

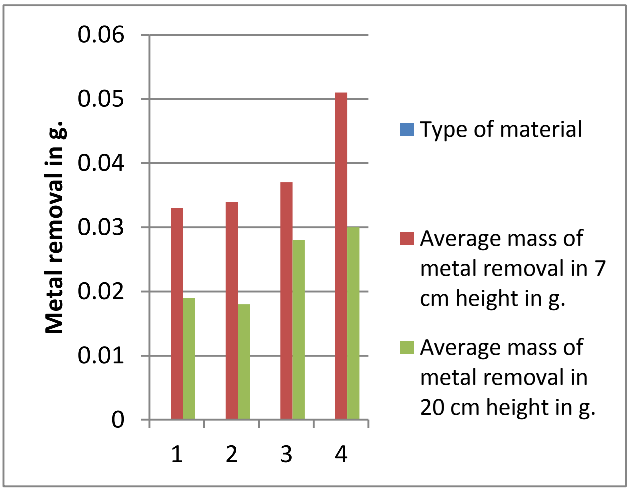


Chart 2. Average metal removal in different heights of working media as indicated in table 2 & 3.

IV. Conclusion

As indicated in the above tabulated results and charts that average metal removal decreases in case of vertical placement of working chambers even if they have the same volume to horizontally placed working chambers and average metal removal reduced in the case of height increment of working medias as indicated in the second chart for both the materials.

This study contains certain limitations and can be further developed concerning to the actual results in future research. In the operation of vibration machining the movement of specimens random throughout the working chamber due to this the effect of average metal removal varies from operation to operation, as indicated in the 2nd chart because of its intensive factor differences:

1. Pressure varies in different positions of the working chamber;
2. Working medium quality;
3. Type, concentration and circulation rate of fluid used in the working chamber and others.

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- The change of metal removal rate and surface finish on vibration machining, Ambachew Maru Woubu, Guteta Kabeta Weyessa, International Journal of Sciences: Basic and Applied Research (IJSBAR) 215. –volume 24№ 6, pp277 – 283.
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