iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** XI **Month of publication:** November 2022

DOI: https://doi.org/10.22214/ijraset.2022.47319

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue XI Nov 2022- Available at www.ijraset.com

Internal Surface Enhancement by Magnetic Abrasive Finishing of Brass Pipe at Different Speeds and Particle Composition

Piyush Dhingra[1], Charanjit Singh[2]
[1]*Master Student, Department of Mechanical Engineering, Shaheed Udham Singh College of Engineering & Technology, Tangori, Mohali.*
[2]*Assistant Professor, Department of Mechanical Engineering, Shaheed Udham Singh College of Engineering & Technology, Tangori, Mohali.*

Abstract: This study examined the effect of magnetic field on the interior surface finish of Brass UNS C26800 pipe. The parameters sliding velocity of electromagnets, concentration ratio (castor oil and magnetic abrasive particles), and number of cycles were modified within a predetermined range, and their effects on surface finish (%Ra) and material removal rate were determined (MRR). The remaining process parameters remained unchanged throughout the duration of the experiment. In the case of 7:3 and 8:1 concentration ratios, the percentage improvement in surface finish (%Ra) increases and subsequently drops as the sliding velocity of electromagnets increases. The only explanation is because the blunting of abrasives occurs at greater sliding speeds, which reduces the improvement of surface finish. In the event of a concentration ratio of 9:1, however, the percentage increase in surface finish increases with the increase in sliding velocity as a result of the work hardening of the surface, which enables the simple removal of surface peaks. Also, for sliding velocities of 0.62 mm/sec and 1.23 mm/sec, the percentage improvement in surface finish falls with increasing concentration ratio due to the slurrification of magnetic abrasives in the lubricant as a result of increasing oil concentration. At a sliding velocity of 2.46 mm/sec, the improvement in surface finish is proportional to the amount of oil applied due to the increased control and velocity of the surface. In addition, two cycles of electromagnets relative to the workpiece provided the finest surface finish. The MRR increases as sliding velocity increases. Consequently, MRR is minimal at the slowest sliding velocity.

I. INTRODUCTION

In practically all engineering applications, the surface finish has a substantial effect on the surface properties, including wear and friction. Examples of these characteristics include: This directly impacts the surface finish (Mulik and Pandey, 2010). MAF, which stands for magnetic abrasive finishing, is an innovative finishing technique that employs a combination of ferromagnetic particles and abrasives as a cutting tool, with the aid of a magnetic field that regulates the amount of abrasion pressure that is applied (Tsai et al., 2012). The magnetic abrasive finishing approach for non-ferrous materials has been developed to increase the magnetic flux density, which has a direct effect on the contact force between the workpiece and the abrasives (Dong et al., 2012).

According to published study, a variety of various analytical factors (such as spindle speed, type of abrasives, electromagnet workpiece gap, % weight of abrasives, magnetic flux density, number of cycles, processing duration, etc.) were examined for optimization purposes. These settings included spindle speed, abrasive type, electromagnet workpiece gap, abrasive weight %, and more.

The great majority of research have focused on the surface finishing of the pipe at a particular location along its length. For the interior surface of the pipe to be correctly completed, it must meet the criteria of actual applications. On a lathe, electromagnets replace the tool post so that the entire surface may be polished. So that the electromagnets may be moved, it is necessary to construct a sliding mechanism. This research examined the effects of adjusting the sliding velocity of electromagnets on the surface finish and the amount of material removed per unit of time.

By combining magnetic abrasives with oil, the internal finishing of pipes may be improved and handled with more accuracy (Jha and Jain, 2004). To our knowledge, however, not a single research has been conducted to examine the effect of altering the oil-to-abrasive concentration ratio.

Castor oil coupled with magnetic abrasive particles is utilised in the nano finishing operation so that a better degree of overall control may be achieved (MAP). To improve the accuracy and dependability of the MAF process, surface roughness profiles formed by cutting with Fe_3O_4 abrasives mixed with Fe powder at various castor oil concentrations have been compared.

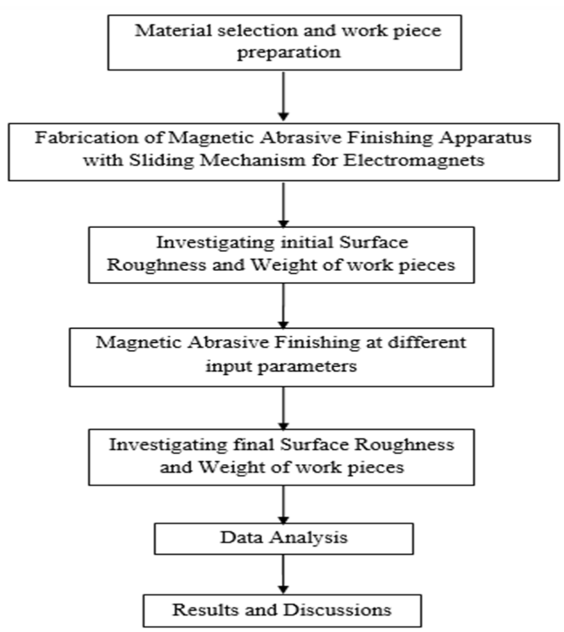
In addition, several studies indicate that the number of cycles utilised in the MAF operation is a vital part of the procedure. Adjustments have been made to the number of cycles in order to provide a controlled and effective surface. The conclusion that will receive the most favourable audience response. In addition to what has already been said, the conclusions have been objectively confirmed by the experiments.

Consideration was given to a comprehensive factorial experimental design in order to determine the effect of analytical factors on surface quality as well as the rate at which material is removed from the surface. These factors include the electromagnet's sliding velocity, the ratio of abrasive mixture to castor oil concentration, and the number of magnetic cycles. The other experimental parameters, including the quantity of current utilised, the kind of abrasive employed, the magnetic flux density, the work piece gap, the voltage, and the spindle speed, were held constant throughout the experiment.

II. OBJECTIVES

1) To research the effect of magnetic abrasive powder to castor oil concentration ratio on magnetic abrasive finishing.
2) Examine the impact of varying magnetic sliding velocity on the interior surface roughness of brass pipes.
3) Determine the optimal input parameter settings for minimal surface roughness and material removal.

III. METHODOLOGY



IV. RESULTS AND DISCUSSION

A. *Effect of Parameters on Surface Finish*

When it comes to minimizing friction losses in pipes made of different materials, surface polish is a crucial element. Better fluid flow can be attained with a higher quality surface. The surface polish will improve according to the surface roughness reduction, and vice versa. Several parameters, including sliding velocity, concentration ratio, and the number of cycles, were examined for their effect on surface roughness, and the following equation was used to calculate %Ra (the percentage improvement in surface finish):

$$\%\Delta Ra = \frac{(\text{Initial Roughness} - \text{Final Roughness})}{\text{Initial Roughness}} \times 100$$

1) Effect of Sliding Velocity on surface finish with concentration ratio 7:3

The ideal value of%Ra is reached when the sliding velocity is 1.23 mm/sec, as shown in Figure 5.1. When the sliding velocity surpasses a certain threshold, the percentage improvement in surface polish increases, but only up to that point; it thereafter begins to decrease. In addition, Pashmforoush and Rahumi (2015) found that the surface roughness got smoother for the first 20 minutes following the start of the trial, before becoming uneven again. When finishing time was increased further, the percentage gain in surface polish decreased, which may have been due to the abrasives becoming blunted or contaminated by chips created during the finishing process. According to Mishra and colleagues (2013), the rubbing action of magnetic abrasive particles on the work surface creates significant frictional forces, resulting in the degradation of the abrasives. The frictional force increases after an increase in the linear velocity of electromagnets, which is followed by a high spindle speed that blunts the abrasives. As a result of blunting, abrasives' ability to cut becomes less effective over time. Consequently, this may be the reason why %Ra lowers when a particular sliding velocity is reached. Djavanroodi (2013) also argued that the progressive rise in surface polish results from the blunting of the abrasive particles' sharp edges. Therefore, when electromagnets slide at high velocities, the particles become blunt and the cutting forces may experience a drop; hence, the value of %Ra decreases at very high velocities. As a result of these variables, the % improvement in surface polish at a sliding velocity of 2.46 millimetres per second exhibits a declining pattern.

Table 5.1 %ΔRa at different parameters

OrderNo.	No. of Cycles	Sliding Velocity (mm/sec)	ConcentrationRatio (vol.)	Ra Before Finishing(μm)	Ra After Finishing(μm)	%ΔRa
1.	2	0.62	7:3	0.295	0.183	37.78
2.	2	1.23	7:3	0.348	0.207	40.43
3.	2	2.46	7:3	0.208	0.186	10.46
4.	2	0.62	8:2	0.263	0.191	27.24
5.	2	1.23	8:2	0.310	0.212	31.58
6.	2	2.46	8:2	0.281	0.238	15.38
7.	2	0.62	9:1	0.227	0.188	17.16
8.	2	1.23	9:1	0.235	0.185	21.19
9.	2	2.46	9:1	0.267	0.170	36.42
10.	1	0.62	7:3	0.246	0.198	19.51
11.	1	1.23	7:3	0.292	0.208	28.76
12.	1	2.46	7:3	0.272	0.208	23.55
13.	1	0.62	8:2	0.229	0.188	17.80
14.	1	1.23	8:2	0.254	0.183	27.93
15.	1	2.46	8:2	0.244	0.192	21.29
16.	1	0.62	9:1	0.230	0.209	9.04
17.	1	1.23	9:1	0.230	0.193	16.07
18	1	2.46	9:1	0.235	0.161	31.24

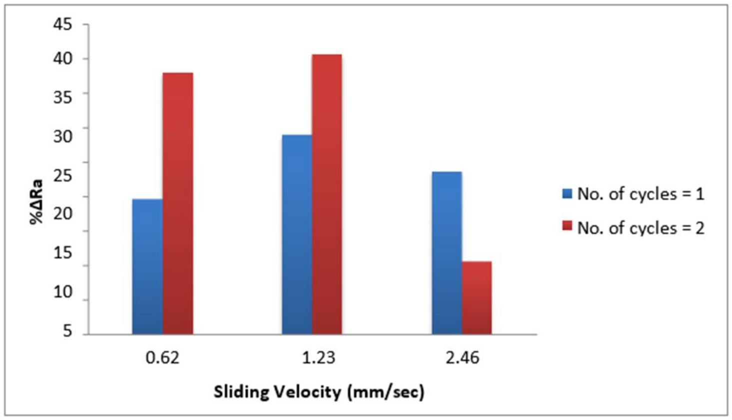


Figure 5.1 Effect of sliding velocity on surface finish with concentration ratio 7:3

2) Effect of Sliding Velocity on surface finish with concentration ratio 8:2

As illustrated in Figure 5.1, the optimal value of %Ra can be obtained when the sliding velocity is 1.23 mm/sec. This is evident when examining the graph. When the sliding velocity exceeds a particular threshold, the percentage of improvement in surface polish will increase; however, this impact will only persist up to that point; after that, it will begin to diminish. In addition, Pashmforoush and Rahumi (2015) discovered that the surface roughness became smoother twenty minutes after the start of the test, before becoming uneven again. It is likely that the abrasives became blunted or contaminated throughout the finishing process, resulting in a decrease in the percentage gain in surface polish as the finishing time was increased. According to studies conducted by Mishra and colleagues (2013), magnetic abrasive particles rubbing against a work surface generate high frictional forces, which degrade the abrasives. After a rise in the linear velocity of the electromagnets, the frictional force increases, which is subsequently followed by a high spindle speed that blunts the abrasives. Due to a phenomenon called as blunting, the ability of an abrasive to cut becomes less efficient over time. As a result, it is probable that this explains why %Ra reduces when a certain sliding velocity is attained. According to Djavanroodi (2013), the steady rise in surface polish is caused by the blunting of the abrasive particles' edges. This was again another of his arguments. As a result, when electromagnets slide at extremely high velocities, the particles become blunt and the cutting forces may decrease; hence, the value of %Ra decreases at these extremely high velocities. There is a diminishing tendency in the percentage of surface polish improvement at a sliding velocity of 2.46 millimetres per second due to these reasons.

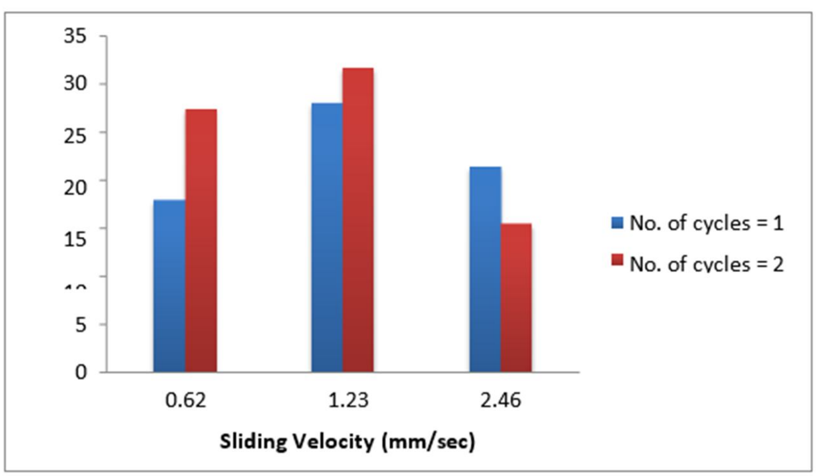


Figure 5.2 Effect of sliding velocity on surface finish with concentration ratio 8:2

3) Effect of Sliding Velocity on surface finish with concentration ratio 9:1

As can be seen in Figure 5.3, the value of %Ra that yields the best results is reached when the sliding velocity is set at 2.46 millimetres per second. When the sliding velocity is raised, the quality of the surface finish improves in a manner that is proportionate to the degree of the increase.

There is a significant difference in the outcomes when comparing the 7:3 concentration ratio to the 8:2 concentration ratio. In addition, an increasing trend of %Ra can be seen over the whole graph period, as shown in Figure 5.3. This pattern has been detected during the entire era. Due to the fact that castor oil also functions as a lubricant, a higher concentration of castor oil helps to avoid blunting of the abrasives, which in turn enables a more efficient cutting motion.

When a greater quantity of castor oil is provided, there is a corresponding increase in the sliding speeds, which in turn causes the surface smoothness to substantially improve. Castor oil works as a lubricant at high speeds of magnetic abrasive particles and counteracts the blunting force produced by the abrasives. This enables castor oil to provide the desired effect. Singh et al. (2008) hypothesised that the quantity of material removal and %Ra for a particular process parameter setting will rely on the work surface's potential for quick work hardening and subsequent embrittlement in addition to its capacity for wide plastic flow. This is because the work surface's capacity for rapid work hardening and subsequent embrittlement will depend on the work surface's capacity for broad plastic flow. This is due to the fact that the capacity of the work surface to undergo a high rate of work hardening and subsequent embrittlement will have an effect on the amount of material that is removed and %Ra. Brass has an extremely limited capacity for plastic flow, but a significant propensity toward work hardening and, as a result, brittleness. Brass is brittle due to the particular characteristics that it possesses in combination. As a consequence of this, when the sliding velocity is high, the temperature at the contact rises, the surface gets work-hardened, and in the end, it breaks easily. As a consequence of this, the surface lips grow progressively more brittle until they are finally capable of being readily shattered by the sharp abrasives that are moving at an extremely high speed. The phenomena of material embrittlement predominates in this situation (with a concentration ratio of 9:1), which results in improved cutting action at high velocities as a direct consequence. When a substantial quantity of castor oil is supplied at very high speeds, the change in surface finish is amplified as a result of these concerns. Additional research might be carried out with a ninefold increase in the sliding velocity from the previous study.

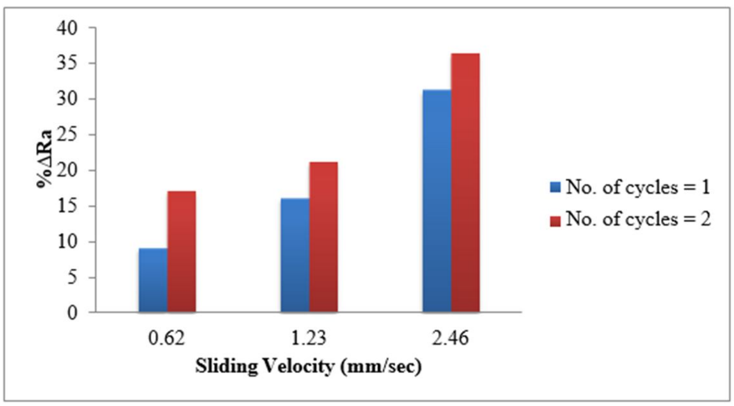


Figure 5.3 Effect of sliding velocity on surface finish with concentration ratio 9:1

4) Effect of concentration ratio on surface finish at sliding velocity 0.62 mm/sec

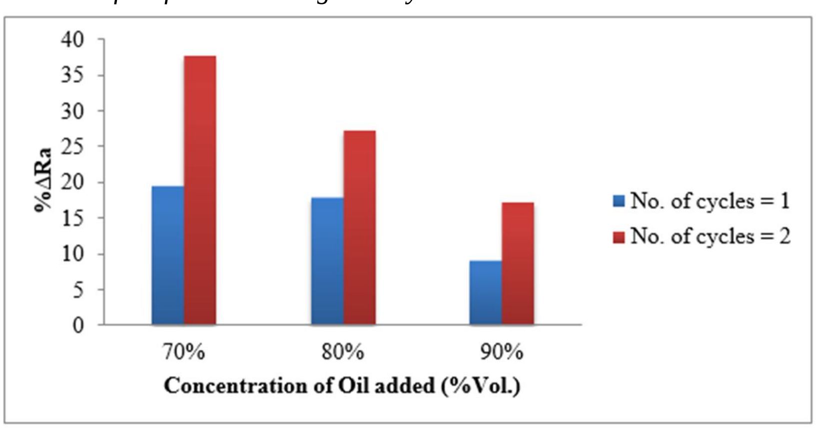


Figure 5.4 Effect of concentration ratio on surface finish at sliding velocity 0.62 mm/sec

As shown in Figure 5.4, the amount of castor oil applied to magnetic abrasive particles correlates directly with the percentage of surface quality improvement that can be accomplished. When the concentration ratio is 7:3 and the sliding velocity is 0.62 mm/sec, it is possible to produce a more polished surface. This may be because a larger proportion of oil causes the abrasive mixture to get slurred, preventing it from producing the requisite cutting power on the workpiece's surface. This is because there is substantially less rubbing action when particles slide with a lower velocity.

According to Patil et al. (2012), an excessive supply of lubricant might either cause fluid lubrication between the abrasives and the workpiece or wash the abrasives out of the finishing zone. The slurrification of the magnetic abrasives in the lubricant could have been produced by an excessive amount of lubricant or oil. This disrupts the finishing process because it reduces the number of cutting blades that are in contact with the surface.

5) Effect of concentration ratio on surface finish at sliding velocity 1.23 mm/sec

Figure 5.5 demonstrates that when the concentration ratio increases at a sliding velocity of 1.23 mm/sec, the percentage increase in surface polish falls. At a sliding velocity of 0.62 mm/sec, the outcomes appear to be identical. As was discussed in the section that came before this one, the magnetic abrasives slurrified in the lubricant as the oil concentration grew. This caused fluid lubrication to occur between the abrasives and the workpiece, or it removed the abrasives from the finishing zone entirely. Because of these considerations, the degree of improvement in surface smoothness that results from an increase in the amount of oil provided is proportional to a drop in sliding speed when the sliding speeds are low to moderate.

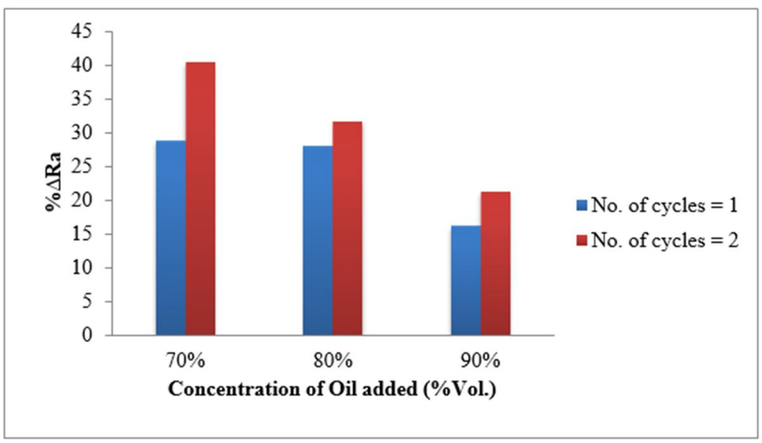


Figure 5.5 Effect of concentration ratio on surface finish at sliding velocity 1.23 mm/sec

6) Effect of concentration ratio on surface finish at sliding velocity 2.46 mm/sec

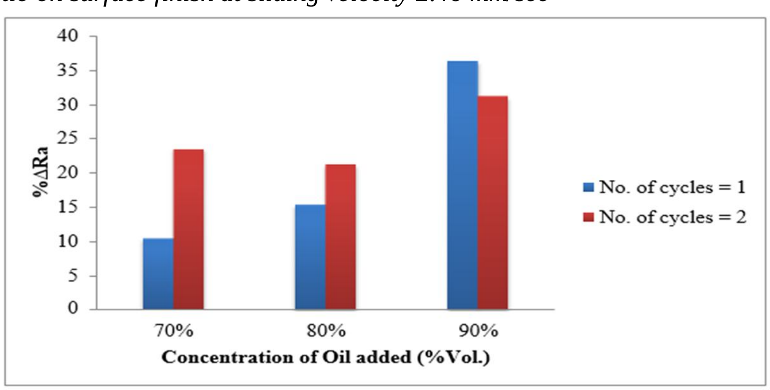


Figure 5.6 Effect of concentration ratio on surface finish at sliding velocity 2.46 mm/sec

Figure 5.6 demonstrates that there is a clear correlation between the volume of oil injected and the level of improvement in surface polishing achieved. The results of sliding at velocities of 0.62 mm/sec and 1.23 mm/sec couldn't be any more different from one another. When the electromagnets are moving at a high sliding velocity, the particles travel at a very high linear velocity, which is followed by a high spindle speed that carries the workpiece.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue XI Nov 2022- Available at www.ijraset.com

When the electromagnets are moving in this way, the linear velocity of the particles is extremely high. Therefore, an adequate amount of lubrication applied at high velocities will result in improved surface control that is more uniform. Therefore, cutting forces are formed largely by the increased relative speed of the abrasives, which works against the phenomena of fluid lubrication induced by a larger oil concentration. This results in the creation of more cutting forces. Additionally, it is probable that the abrasives will become blunt when subjected to greater sliding velocities. [Citation needed] An increase in the amount of oil reduces the blunting impact of the abrasive, which leads to an increase in the amount of improvement in surface polish.

B. *Effect of Parameters on Material Removal Rate (MRR)*

The influence of a variety of analytical factors, including sliding velocity and concentration ratio, was observed and the corresponding Material Removal Rate (g/min) was estimated by utilising the equation that is presented below. These results may be found in Table 5.2.:

$$\text{MRR} = \frac{(\text{Initial weight} - \text{Final weight})\ \text{in g}}{\text{Processing time (min.)}}$$

Table 5.2 MRR at different parameters

Order No.	No. of Cycles	Sliding Velocity (mm/sec)	ConcentrationRatio (vol.)	Weight Before Finishing (g)	Weight After Finishing (g)	MRR (g/min)
1.	2	0.62	7:3	192.68	192.64	0.002
2.	2	1.23	7:3	195.48	195.44	0.004
3.	2	2.46	7:3	195.92	195.88	0.009
4.	2	0.62	8:2	195.56	195.54	0.001
5.	2	1.23	8:2	195.86	195.82	0.004
6.	2	2.46	8:2	196.00	195.96	0.009
7.	2	0.62	9:1	199.46	199.42	0.002
8.	2	1.23	9:1	195.60	195.58	0.002
9.	2	2.46	9:1	198.04	198.00	0.009
10.	1	0.62	7:3	196.04	196.02	0.002
11.	1	1.23	7:3	197.50	197.46	0.009
12.	1	2.46	7:3	197.18	197.16	0.009
13.	1	0.62	8:2	194.26	194.22	0.004
14.	1	1.23	8:2	197.08	197.02	0.014
15.	1	2.46	8:2	195.42	195.38	0.018
16.	1	0.62	9:1	195.92	195.88	0.004
17.	1	1.23	9:1	197.12	197.08	0.009
18	1	2.46	9:1	194.44	194.40	0.018

1) *Effect of Sliding Velocity on Material Removal Rate (MRR) with concentration ratio7:3*

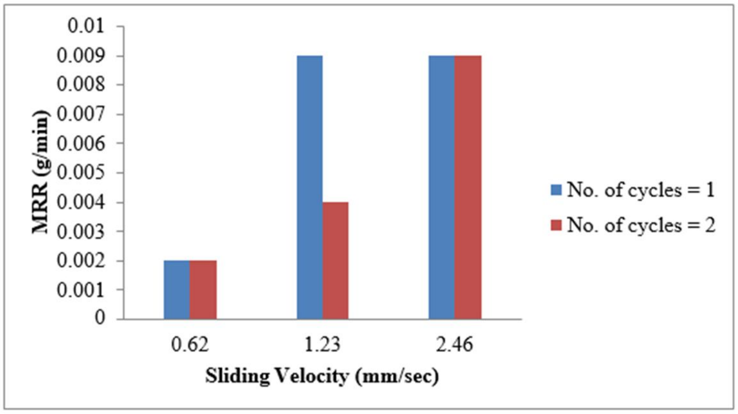


Figure 5.7 Effect of sliding velocity on MRR with concentration ratio 7:3

Figure 5.7 depicts the link between the number of cycles and the material removal rate. When the concentration ratio is 7:3, it can be observed that as the sliding velocity of electromagnets increases, so does the rate at which material is removed. However, as the number of cycles grows, this rate lowers. This is due to the inverse relationship between MRR and processing time, which explains why this is the case. Reduced processing time contributed to the higher MRR that was realised as a result of the improved sliding velocity. In contrast, the current work removes roughly the same quantity of material from the work surface independent of process parameters.

2) *Effect of Sliding Velocity on Material Removal Rate (MRR) with concentration ratio8:2*

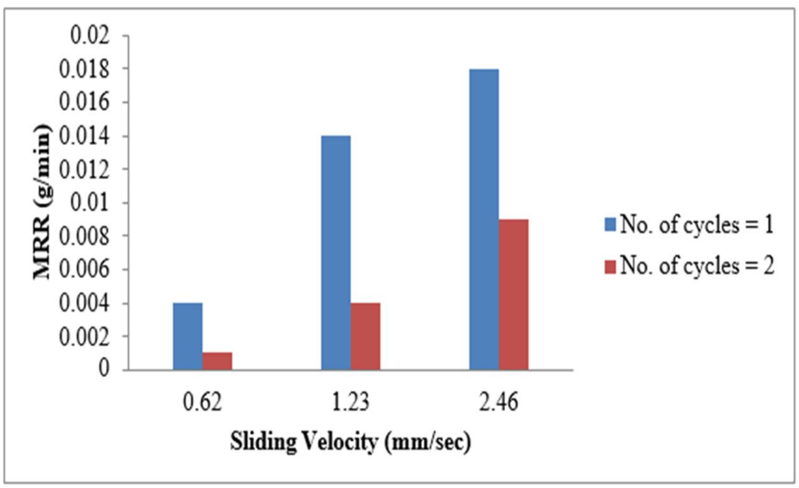


Figure 5.8 Effect of sliding velocity on MRR with concentration ratio 8:2

Figure 5.8 demonstrates that there is a correlation between an increase in the sliding velocity of electromagnets and a commensurate increase in the rate of material removal when the concentration ratio is 8:2. This is illustrated by the fact that there is a direct proportional relationship between the two variables. When the concentration ratio is 7:3, one sees the same effects as before. This is due to the fact that the rate of material removal slows down dramatically as the number of cycles electromagnets are exposed to increases. As previously stated, MRR is a phenomenon that occurs throughout time. The MRR decreased automatically in proportion to the lengthening completion time. Brass, unlike aluminium, is a rather hard metal. With the use of abrasive action, its surface peaks may be easily removed; however, the flow of metal deposited on the surface of aluminium plastic cannot be removed as easily (Singh et al., 2008). Consequently, MR is almost identical in both instances, but brass gives the highest surface polish with the least amount of metal removal (MR). Consequently, this is the only explanation for why MR is nearly unchanged in our study but %Ra undergoes substantial change.

3) Effect of Sliding Velocity on Material Removal Rate (MRR) with concentration ratio9:1

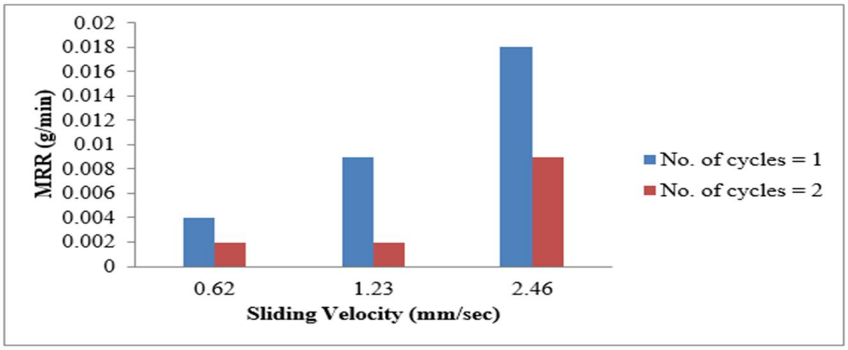


Figure 5.9 Effect of sliding velocity on MRR with concentration ratio 9:1

Figure 5.9 illustrates a correlation of 9:1 between an increase in the sliding velocity of electromagnets and a corresponding increase in the rate of material removal. This correlation can be seen in the figure. As was stated before, the rate of material removal will simultaneously slow down as the number of cycles rises, resulting in a concentration ratio of 8:2. Therefore, the best findings for MRR can be obtained by testing at lower velocities, such as 0.5–0.7 mm/sec, with a minimum number of cycles of two.

4) Effect of concentration ratio on MRR at constant sliding velocity

Due to the fact that brass is more durable than aluminium, a superior surface polish can be accomplished with less material removal, as discussed in the preceding paragraphs. Consequently, the amount of material eliminated is comparable in both scenarios. In this instance, the Material Removal Rate (MRR), which is inversely proportional to the length of time that has elapsed, is taken into account. If measured at a constant sliding velocity (0.62 mm/sec, 1.23 mm/sec, or 2.46 mm/sec), the MRR would be the same across the whole range of graphs. Due to the fact that if the sliding velocity of an electromagnet is the same for different parameters, the amount of time required to complete a task with those parameters remains the same, this is the case. If the MR and completion time remain unchanged, the MRR will also remain unchanged in proportion to the constant sliding velocity.

C. Surface roughness profiles before and after Magnetic Abrasive finishing process

A Mitutoyo Surftest SJ-210 surface roughness tester was utilised in the process of evaluating the smoothness of the inside surfaces of the pipes that were utilised in the experiment, both before to and during the conduct of the experiment. The utilisation of these readings in conjunction with a communication tool might allow for the construction of profiles. The trials were chosen at random based on a number of process characteristics that, when compared to one another, gave the greatest results across the entire procedure. The trials were picked depending on which process features yielded the best results. The roughness profiles of experiment number 14 are shown before and after the finishing procedure in figure 5.7. In the experiment, the sliding speed was set at 1.23 millimetres per second, the concentration ratio was set at 8:2, and the cycle count was set at 1.

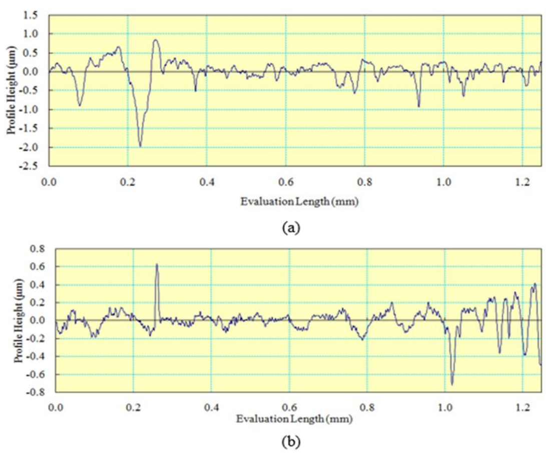


Figure 5.10 Roughness profiles of experiment no. 14 (a) Before Finishing (b) After Finishing

Figure 5.10 illustrates that the profile's maximum height before it is finished is around 2.75 metres, but that once it is finished, the profile's maximum height is approximately 0.9 metres. Because of this, it can be deduced that magnetic abrasive finishing, which is aided by magnetorheological finishing, helps to smooth the surface and reduces the number of grooves or ploughs that are already present. This, in turn, causes a change in the average profile height of the roughness diagram.

The roughness profiles before and after the Magnetic Abrasive Finishing Process of trial no. 9 with a sliding velocity of 2.46 mm/sec, concentration ratio of 9:1, and cycle count of 2 are then depicted in Figure 5.11.

In addition, figure 5.11 indicated that the maximum height of the profile prior to and after completion is nearly comparable. However, the profile curve varies along the sampling length prior to and following completion. After an evaluation length of 0.5 mm, the graph becomes stable toward the centre line. The average roughness, given by Ra, will have been improved following the finishing step.

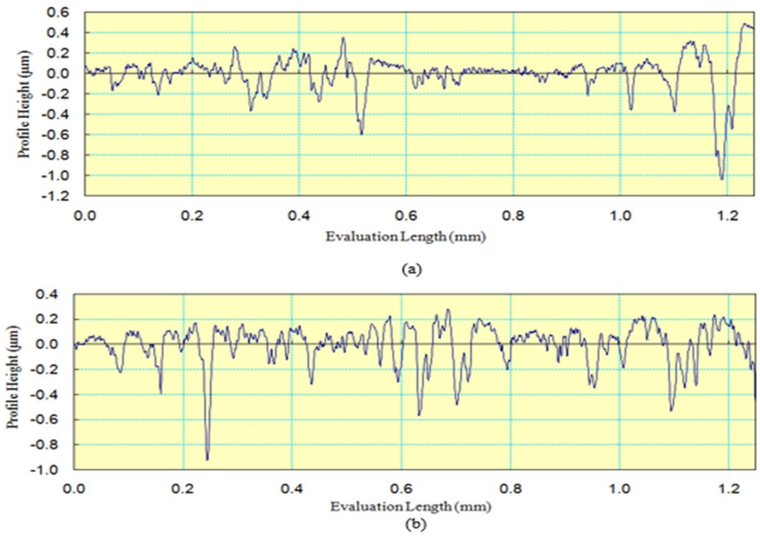


Figure 5.11 Roughness profiles of experiment no. 9 (a) Before Finishing (b) After Finishing

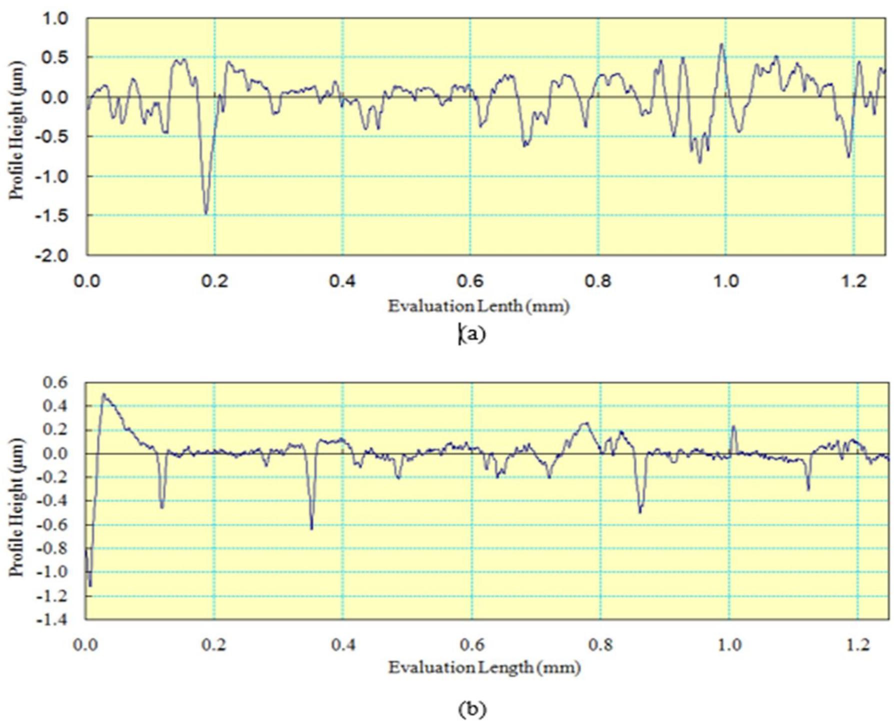


Figure 5.12 Roughness profiles of experiment no. 2 (a) Before Finishing (b) After Finishing

Figure 5.12 depicts the roughness profiles of the surface of experiment no. 2 before and after the finishing process, which was performed at a sliding velocity of 1.23 mm/sec and a concentration ratio of 7:3 using two cycles of electromagnets.

As depicted in Figure 5.12, the maximum profile height after completion is approximately 1.6 metres. The maximum profile height prior to completion is roughly 2 metres. Consequently, there is a decrease in maximum profile height and the graph is steady toward the centre line after the finishing process, resulting in a significant decrease in average roughness (Ra) throughout the procedure. This is due to the stability of the graph following the finishing procedure.

V. CONCLUSION

The investigational factors presented in this study, such as sliding velocity, concentration ratio, and number of cycles, have a substantial impact on the Brass UNS C26800 pipe. The investigation yields the following findings:

1) The concentration ratio and the number of cycles are the two most important factors in this study, although the electromagnets' sliding velocity is the most important parameter in terms of the percentage increase in surface finish (%Ra) and the MRR.
2) Depending on whether the concentration ratio is 7:3 or 8:1, as the sliding velocity rises, the percentage improvement in surface polish first improves, but then drops. This occurs owing to the electromagnet's fast sliding speed, which blunts the abrasives.
3) The percentage of improvement in surface finish increases as sliding velocity increases while employing a concentration ratio of 9:1. (Castor oil and magnetic abrasive particles). The larger amount of castor oil prevents the blunting of abrasives, whilst the work hardening of the substance enables the effortless removal of surface lips from the parent metal at high cutting speeds.
4) The amount of castor oil added to an abrasive mixture has a considerable influence on the percentage of relative abrasion when the sliding velocity is maintained constant. Because an excessive supply of lubricant at low sliding speeds might induce fluid lubrication between the abrasives and the workpiece or wash the abrasives away from the finishing area, %Ra decreases with increasing concentration ratio at sliding speeds of 0.62 mm/sec and 1.23 mm/sec.
5) However, when the sliding velocity is 2.46 millimetres per second, the %Ra value increases as the concentration ratio increases due to the effective control of the lubricant at higher sliding velocities. In contrast, the blunting of abrasives generated by a strong rubbing action reduces when more oil is introduced.
6) Similarly, the material removal rate (MRR) increases as the sliding velocity increases, and this is true in all cases. The MRR has a negative association with the processing time of the action being performed. Therefore, when velocity is increased, processing time is decreased and MRR increases. Therefore, the MRR reaches its maximum value when the electromagnets' sliding speeds are decreased.
7) In addition, the surface polish of electromagnets improves as the number of cycles increases, according to numerous researchers.
8) After magnetic abrasive finishing with nano sized abrasive particles and micro sized iron particles, the surface roughness was reduced from 0.348 m to 0.207 m. Therefore, the maximum feasible improvement in surface polish (%Ra) was calculated to be 40.43 percent when the sliding velocity was 1.23 mm/s and the concentration ratio was 7 to 3.

REFERENCES

[1] Amineh, S.K., Tehrani, A.F. and Mohammadi, A. (2013), "Improving the surface quality in wire electrical discharge machined specimens by removing the recast layer using magnetic abrasive finishing method", International Journal of Advance Manufacturing Technology, Vol. 66, pp. 1793-1803.
[2] Anjaneyulu, K., & Venkatesh, G. (2019). Optimization of process parameters of magnetic abrasive finishing using Jaya algorithm. Materials Today: Proceedings, 41, 1035–1040. https://doi.org/10.1016/j.matpr.2020.06.568
[3] Anjaneyulu, K., & Venkatesh, G. (2022). On surface integrity of Hastelloy C-276 using chemo based ultrasonic assisted magnetic abrasive finishing process. Sadhana - Academy Proceedings in Engineering Sciences, 47(4). https://doi.org/10.1007/s12046-022-01967-3
[4] Barman, A. and Das, M. (2017), "Design and Fabrication of a Novel Polishing Tool for Finishing Freeform Surfaces in Magnetic Field Assisted Finishing (MFAF) Process", Precision Engineering, Vol. 16, pp. 41-59.
[5] Bedi, T.S. and Singh, A.K. (2015), "Magnetorheological Methods for Nanofinishing – A Review", Particulate Science and Technology, International Journal, Vol. 34, No. 4, pp. 412-422.
[6] Babbar, A., Sharma, A., & Singh, P. (2021). Multi-objective optimization of magnetic abrasive finishing using grey relational analysis. Materials Today: Proceedings, 50, 570–575. https://doi.org/10.1016/j.matpr.2021.01.004
[7] Cheng, M., Chen, S., Xu, J.-W., Zhang, X.-F., Chen, Y., & Han, B. (2021). Experimental research on precision grinding of inner surface of elbow based on profile recognition. Surface Technology, 50(11), 372–382. https://doi.org/10.16490/j.cnki.issn.1001-3660.2021.11.040
[8] Chang, G.W., Yan, B.H. and Hsu, R.T. (2002), "Study on cylindrical magnetic abrasive finishing using unbounded magnetic abrasives", International Journal of Machine Tools & Manufacture, Vol. 42, pp. 575-583.

1