



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 6, June 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



6381 907 438



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Design & Manufacturing of Tiles Polishing Machine

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ABSTRACT: This project deals with design, development and fabrication of “Special Purpose Machine”. This machine is designed for operations such as Buffing and polishing. This Machine will perform special purpose operation at same time with required speed and this is automatic which is controlled or operated by motor which is run with the help of electric power supply. Industries are basically meant for production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investment and expenditure. Every industry tries to achieve high productivity maintaining the quality and standard of the product at low average cost.

We are going to develop a machine which would be capable of performing buffing and polishing operations simultaneously at high efficiency. This Special Purpose Machine using hydraulic cylinders will be used for precise height adjustment and pressure. The productivity and the quality of the work will increase by this machine. The use of Special Purpose Machine minimizes the possibilities of human errors.

KEYWORDS: Special Purpose Machine, Tiles polishing machine, buffing, polishing Conventional Machining, Automation, Productivity.

I. INTRODUCTION

Ceramic tiles are the common decoration material for floors and walls of hotel, office, and family buildings. Nowadays, polished vitreous ceramic tiles are more popular as decoration material than general vitreous ceramic tiles as they can have a beautiful gloss on different colors. Grinding and polishing of ceramic tiles play an important role in the surface quality, cost, and productivity of ceramic tiles manufactured for decoration. The grinding and polishing of ceramic tiles are carried out in one pass through polishing production line with many different grinding wheels or by multi passes on a polishing machine, where different grinding wheels are used. Most factories utilize the grinding methods similar to those used for stone machining although the machining of stone is different from that of ceramic tiles. Vitreous ceramic tiles are thin, usually 5–8mm in thickness, and are a sintered material, which possess high hardness, wear resistance, and brittleness.

In general, the sintering process causes surface deformation in the tiles. In the machining process, the ceramic tiles are unfixed and put on tables. These characteristics will cause easy breakage and lower surface quality if grinding wheel or grinding parameters are unsuitable. To meet the needs of ceramic tiles machining, the machinery, grinding parameters (pressure, feed speed, etc.), and grinding wheels (type and mesh size of abrasive, bond, structure of grinding wheel, etc.) must be optimized.

II. PROBLEM DEFINATION

By conventional polishing methods, only one tile can be polished at a time, resulting in lesser production. Today's industrial requirements demand faster production with increased same surface finish.

Common problems faced by conventional machining are complicated jig and fixture design to hold component and guide the polishing tool and to adjust the pressure of the polishing machine on the tile.

Performing polishing and buffing operation simultaneously on in single pan was a bigger problem for manufacturing

company, individual polishing and Buffing machines were exist in the market, but they were not beneficial for workshop holders, small industrialist and entrepreneurs to buy separately due to very high cost. Current the Shree Samarth engineers, MIDC, Shirol is using normal polishing machine for polishing
By conventional polishing machine they polishes 700 tiles in a span of 8hrs polishing each tile require 2-3mins.

Solution: By manufacturing the time required for each polishing tile is 40-50 second therefore in one shift of 8 hours 700 tiles are been polished. So Sai Industries has been decided to manufacture for tile polishing & buffing.

III. LITERATURE REVIEW

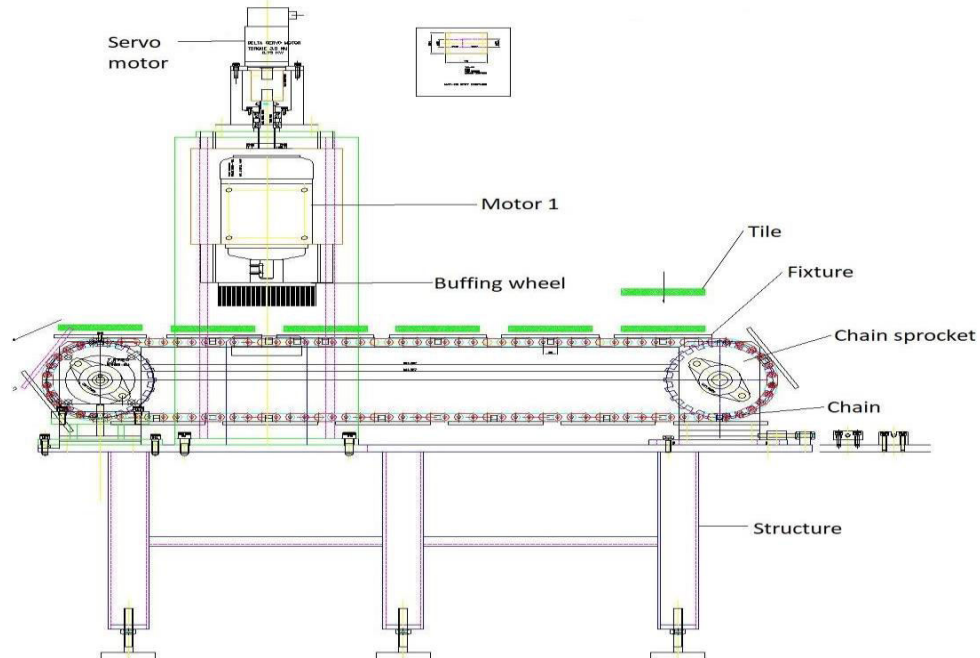
1. **Wang Chengyong et al, (2002)**-Grinding and polishing are important steps in the production of decorative vitreous ceramic tiles. Different combinations of finishing wheels and polishing wheels are tested to optimize their selection. The results show that the surface glossiness depends not only on the surface quality before machining, but also on the characteristics of the ceramic tiles as well as the performance of grinding and polishing wheels.
2. **M. Hutchings et al, (2005)** - Polishing tests on a laboratory scale have been used to simulate and study the industrial polishing process for unglazed porcelain ceramic tiles. Tile surface quality was assessed in terms of roughness and optical gloss.
3. **B Nageswara Rao et al, (2014)**-Polishing is done by various abrasive blocks such as numbers 1, 2, 3, 4, 5 (generally used in granite workshops) or numbers 36, 80, 120, 220, 400, 800, 1200 (number indicates the gritsize). These abrasives are available in different sizes and shapes depending upon the type of the machines.
4. **Anatolij Olenburg et al, (2014)** in this work, the influence of tool-wear on the evolution of surface quality in terms of gloss and roughness of the polished ceramic tiles is researched. For this, three different curvatures were used to perform the experiments on a laboratory scale CNC-Tribometer with a sequence of progressively smaller silicon carbide abrasive particles embedded in a magnesium oxychloride matrix. To achieve and maintain the curvature of the tool during the tests, a new developed tool holder was used.
5. **Luiz Renato Steiner et al, (2015)** The sludge coming from the polishing process of ceramic tiles, particularly 'porcellanato' and 'monoporosa', results in a large amount of waste that requires disposal in controlled landfills. Consequently, the financial and environmental costs of land filling are very high. However, the 'porcellanato' and 'monoporosa' polishing residues could be used as supplementary cementations material (SCM) instead of being disposed or landfilled. Therefore, in this study, the synergistic effect of 'porcellanato' and 'monoporosa' polishing residues (MixPR) as supplementary cementations materials was reported
6. **S A Sanil et al, (2016)** During the polishing process of porcelain tiles the difference in scratching speed between innermost and peripheral abrasives leads to pressure gradients linearly distributed along the radial direction of the abrasive tool. The aim of this paper is to investigate such pressure gradient in laboratory scale. For this purpose polishing tests were performed on ceramic tiles according to the industrial practices using a custom-made CNC tribometer.
7. **L.G Rosa IDMEC & Dept. of Mechanical Engineering, Institute Superior Technical, University of Lisbon, Av. Rovisco Pais, 1049-001 Lisboa, Portugal et al, (2017)** Considering the published works available at Web of Science™ Core Collection for the period from January 2013 till June 2017, this paper provides a summary of recent research trends and technical achievements all around the world, but focusing on stone processing techniques and methods, including topics like characterization, machining, surface finishing.
8. **Muhammad Kashif Shaikh Ghaffar et al, (2018)**-The purpose of this project is to clean the floors in colleges, hospitals, auditoriums, malls and workshops. The aim of this project work is to design and develop process for cleaning the floor having wet and dry surfaces. It is very useful for cleaning the wet as well as dry floors

IV. DESIGN AND CALCULATION

As shown in diagram 1, there are two chain drive used to mount the fixture on that chain drive. The drive is mounted on 4 sprockets having same size.

The front upper side of the machine having a motor to rotate buffing wheel this motor having 1.5 hp capacities. In back side upper of the motor having a hydraulic cooling system attached with the induction motor to cool the tiles when buffing or polishing is processing. On the top of the machine i.e. on top of the buffing wheel motor having a servo motor connect with polishing motor to adjust the buffing or polishing wheel motor up and down as per requirement that all control by the control panel machine.

In left side of machine has a planetary gear box with motor attached. That motor is connected with chain sprocket on



the left side shown in diagram 2. On the chain mount a fixture for clamed tiles. The fixture is manufacture as purpose we can mount or dismount easily. When tiles are clamed on fixture, in left and machine start the buffing or polishing wheel come downward. The process of buffing or polishing is start after buffing or polishing tiles automatically declamed.

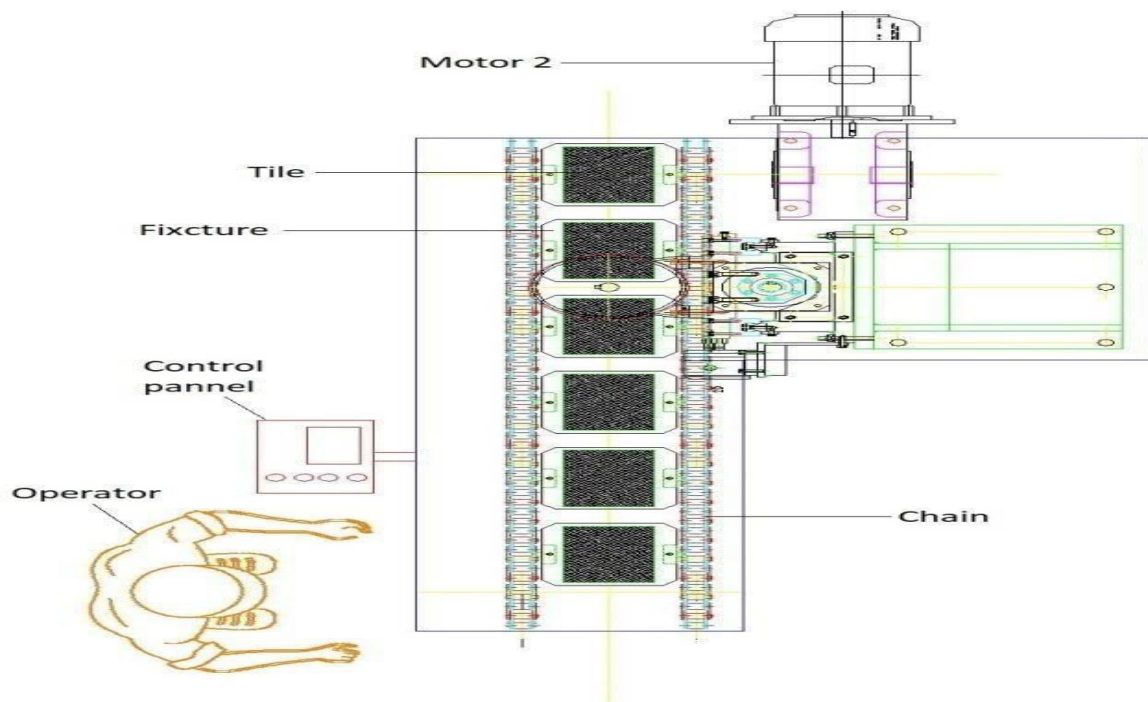


Diagram 1: Front view of machine



1.) Motor Calculation:-

For the machine we had taken directly from the market having capacity of 1.5 kW and 1430 rpm speed now calculation the torque generated from the motor.

P = power of motor in k.w

T = torque generated by motor in N.m

N = speed in rpm

By using power formula

$$P = \frac{2 \pi \times T \times N}{60}$$

$$1.5 \times 1000 = \frac{2 \pi \times T \times 1430}{60}$$

$$T = \frac{1.5 \times 1000 \times 60}{2 \pi \times 1430}$$

$$T = 10.01 \text{ N.m}$$

By this generated torque select the speed of sprocket or chain drive.

2.) Gear Motor Selection:-

For the adjustment of speed using planetary gear box attached with motor and spindle.

i = ratio of input and output spe

T = torque generated by gear m

N = speed of motor in rpm

f = service factor

Diagram 2: Top view of machine

$$i = \frac{\text{input speed}}{\text{output speed}}$$

$$i = \frac{1430}{1000}$$

$$i = 1.43$$

..... (Used for selection or type of

motor)

i. To find a torque

$$T = \frac{P \times 9546}{N}$$

.... (Standard formula)

$$T = \frac{1.5 \times 9546}{1430}$$

$$T = 10.01 \text{ N.m}$$

ii. Finding the out rated torque

$$T_o = T \times f$$

..... (CMTI handbook)

$$= 10.01 \times 1.5$$

..... (Service factor = 1.50)

$$T_o = 15.01 \text{ N.m}$$

From generating the out rated torque select the motor from the requirement.

I.e. model 4180

.....(Manual of gear motor)

3.) Selection of chain and sprocket:-

P = Pitch = 14 mm

Wn = Nominal Top Width = 17mm

Hn = Nominal Height = 11mm

d = Dia of pulley = 225mm



PHW = Power= 921mm from Table No. 13.24 and Table No 13.12 CMTI hand book

By using formula

$$V = \frac{\pi d n}{60 \times 1000}$$

$$V = \frac{\pi \times 225 \times 1440}{60 \times 1000}$$

$$V = 16.96 \text{ m/sec}$$

From that calculate RPM

$$N = \frac{V}{\pi d}$$

$$N = \frac{16.96}{\pi \times 225 \times 10^{-3}}$$

$$N = 1439 \text{ RPM}$$

Determine Max Power

By using formula

$$K_{\max} = K_W + F_a$$

$$K_{\max} = 9.21 \times 1.13$$

$$K_{\max} = 11.97 \text{ KW}$$

Calculate angle of Wrap

$$\alpha_s = 180^\circ \dots\dots\dots (Both \text{ sprocket having same dia})$$

From the table contact factor $F_d = 1$ Table no 13.15 CMTI hand book

Determine max power of purpose of chain selection

$$K_{W \text{ Connected}} = K_{W \max} \times F_d$$

$$= 11.97 \times 1$$

$$K_{W \text{ Connected}} = 11.97 \text{ KW}$$

Calculate dia of pulley = 224 from table 14.1 CMTI hand book

Determine load factor (F_a)

$$F_a = 1.13 \dots\dots\dots \text{from table 13.20 CMTI hand book}$$

Calculating Length

L = Length of chain

C = Centre to centre distance

r = Radius of sprocket

By using formula

$$L = 2C + \pi (2r)$$

$$L = 2(994) + \pi (2 \times 102.5)$$

$$L = 2632.02 \text{ mm}$$

$$L = 2300 \text{ mm} \dots\dots\dots \text{from table 4.7 CMTI hand book}$$

Calculating centre to centre distance

$$L = 2C + \pi (2r)$$

$$2300 = 2C + \pi (2 \times 102.5)$$

$$2300 = 2C + \pi 205$$

$$C = 827.98$$

$$C = 828 \text{ mm}$$

4.) Induction Motor:-

For the cooling purpose used induction motor having the 0.9 k.w power and 1440 rpm

To find current used by motor

P = power in k.w

V = voltage is 440v

I = current in amp

$$P = \sqrt{3} \times V \times I \times \cos \phi \times \text{efficiency}$$



$$I = \frac{P}{\sqrt{3} \times V \times \cos \phi \times \text{efficiency}}$$

$$I = \frac{0.09}{\sqrt{3} \times 1940 \times 0.85 \times 0.85}$$

$$I = 0.1634 \text{ amp.}$$

.... (Efficiency is given on motor i.e. 0.85)

5.) Servo Motor Selection:-

The servo motor is used to buffering motor control the motion upward and downward. As per requirement the load of that motor we direct select that motor from market.

V. CONCLUSION

It is found that the SPM is beneficial for mechanical work shop, small scale industries where Polishing and Buffing operations perform on the same job. SPM machine reduces transportation and operation time and increases the efficiency as well as accuracy of the product. By using conventional machining process, the time required for polishing and buffing operation is about 2-2.50 min's. But we found that by using machine the time required for producing one complete job is reduced to 40-50sec's.

From this we have concluded that the use of special purpose machine is beneficial for processing of tile. It reduces the processing time of the tile and at the same time gives better quality with less number of rejection and defects in the tiles. Hence special purpose machine is useful for processing of tiles.

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