International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 12 No. 1 Jul. 2015, pp. 153-168

http://www.ijias.issr-journals.org/

Modern technology used in the production of porcelain and tableware

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ABSTRACT: The production of porcelain face many obstacles in the Egyptian market, locally and in the international market as well. Some of these challenges include improving production and quality so that it abides by international standard that the Egyptian product greatly lacks. One of the most prominent challenges too is the increasingly huge gap between technology in industrial countries and third world countries. Without this modern technology it is nearly impossible for any country that lacks this technology to be part of this market, not even compete., since modern technology is intrinsic to all the elements of production, and export, which has complicated the market even more since the borders between local and international markets are nearly nonexistent .In a study about the role of manufacturing technology in the provision of Industrial exports to international markets, that the increase in technology leads to the decrease in production cost. Decrease in the quality of elements used and the increase in the elements used in technical production which leads to a reduction in the final product price the production that is high quality and can compete in international markets. The research will portray some of the new machines used in the production of tableware.

KEYWORDS: economy, Isotactic pressing, the press system, porcelain, tableware.

THE RESEARCH PROBLEM

1- There is a real evident gap between the technology used in Egyptian factories and in the global factories.

2- Some factories are in a threat of shutting down since they are unable to compete with international markets, in terms of quality and international standards for exporting, elements that the Egyptian market lacks.

3- The inability of the Egyptian market to keep up with the innovations in the technical and production market of porcelain production.

THE RESEARCH IMPORTANCE

1- From an educational aspect: the development of the academic curriculum of tableware production, in correlation with the international progress in porcelain production, in accordance with the needs of students in the field. .

2- From an economic aspect: the ability to compete internationally in terms of quality, and abiding by international standards.

THE RESEARCH HYPOTHESIS

1- The complete understanding of the state of modern technology in the production of porcelain, leads to an improvement in the curriculum, which enables the students who will be working in the field to be better.

2- The technical and technological progression raises the capability of production which eventually leads to an increase in production capabilities, and supports the Egyptian economy.

OBJECTIVES OF THE RESEARCH

1- To find academic material to explain the progress of technology made in the field of porcelain and tableware.

2- An attempt to minimize the gap between educational institutions and industrial firms , in order for the academic aspect, not only to be aligned with the state of the art technology, but rather be ahead of it.

3- An attempt to improve Egyptian products in order for it to compete internationally.

1 INTRODUCTION

1.1 THE CONCEPT OF TECHNOLOGY

Technology is the application of different scientific discoveries and inventions that are reached through scientific research. From an economic point of view, technology is the improvement of the production process and ways used, that lead to a reduction in production cost and improve process.

It is basically a collection of ideas that are related to scientific applications in the field of industry that leads to an evident progress in the level of production. This is basically a collection of understandings, accumulated experiences, and the financial and managerial means, used by man at work in a specific field, practiced regularly in order to fulfill his material needs.

It is important for developing countries to invest in technology in order for national progress, considering the results of scientific studies on the scientific and technological effect of technological progress in the increase of production in a country. An example of this is found in the United States, where technological strides and progresses contribute from 80% to 90% of the increase in work production. We conclude from this that technological progress leads to an increase in production. Thus developed countries pay a considerable amount of attention to this, where they invest from 2 to 3.5% from national income on scientific and technological research.

1.1.1 TECHNOLOGY TRANSFER

This refers to the exchange of technology easily in order to facilitate its use scientifically. In general this transference of technology is not merely, its exchange but rather an overall exchange of cultures, social aspects and politics. Technology is the outcome of social and economic realities, and thus in industrial countries technology has coincided with the financial and social changes of a country, thus technology was a result of and existed parallel to a balanced environment that supported it with the suitable elements for its development.

Therefore the transference of technology, in reality, is not the ultimate solution for developing countries, unless it is supported by clear developmental policies, through which the proper elements can be provided that will help the process of adaptation and development. This ultimately means that certain changes have to be made to imported technologies that will make them more adaptable and suitable to the condition of the country that they're used in. This change can be successfully achieved by marrying the imported technologies and local elements.

However this governmental support was only one of other ways that were being provided in addition to the motivations and support of technological innovations. One of the most prominent of these ways was tax exemption that were awarded to sectors of technological development, financial aid in the export sector, prepare and educating engineers and scientists, in addition to the other skilled workers who help this technological process more smoothly.

Here "MOVEMENT" used in its generic meaning of transference, through the different economic and industrial channels, that has become the main incentive in international relations as a result of the current issues, political, economic and security strives.

1.2 THE IMPORTANCE OF CERAMIC PRODUCTION AND ITS EFFECTS ON EGYPTIAN ECONOMY:

The following is an illustration of production results in industrial sectors:

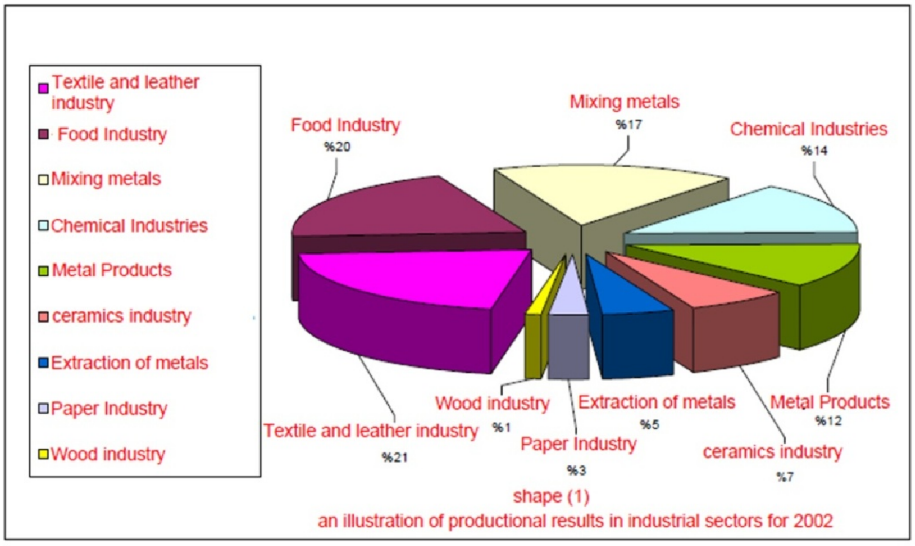


Fig. 1. industrial sector in Egypt

Figure (1) shows the importance of ceramic industry which present 7% form industrial sector in Egypt

Porcelain and tableware production is deemed one of the most important industries.

It is clear that both the porcelain and ceramic industries are equally unattended to; perhaps this goes back to different aspects, one of which is the competition from products produced in China and the policies of drowning that are being followed.

This is illustrated by the number of factories and the rates of production of ceramic tableware.

1.2.1 ELECTRICAL PORCELAIN PRODUCTION LINE

The following is a presentation of the porcelain production line that is used in the production of tableware, starting from assembly to design, as follows:

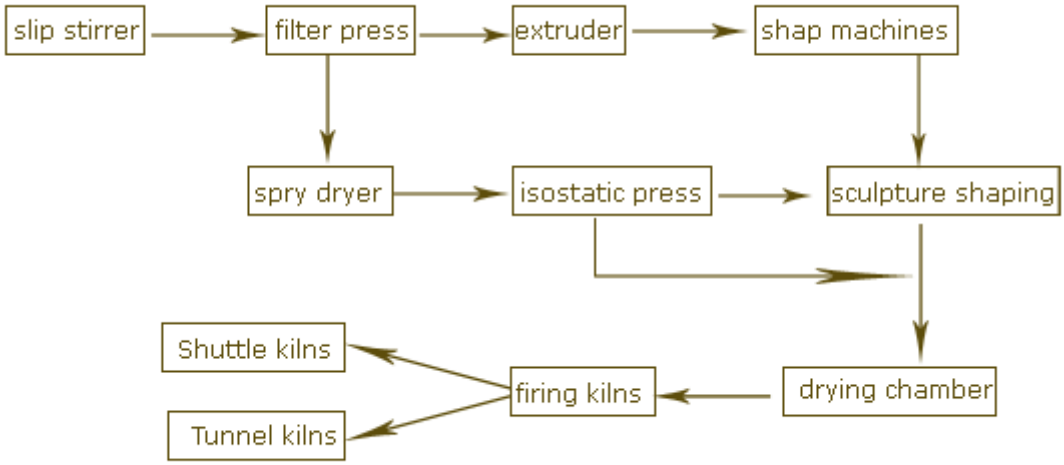


Fig. 2. Electrical porcelain production line

In this paper will concentrate in explaining modern technology in porcelain production in the modulation, glazing and decoration stages.

2 MODULATION

2.1 ISOTACTIC PRESSING OF TABLEWARE

Without plaster moulds without leather hard dryer without back drying of plaster moulds without white dryer .Evenly compacted dry pressed articles without deformation without loss of shape stability without alterations in article size without wearing relief work

With compressed –air fast granulate filing system With approved fully isostatic operating pressing dies

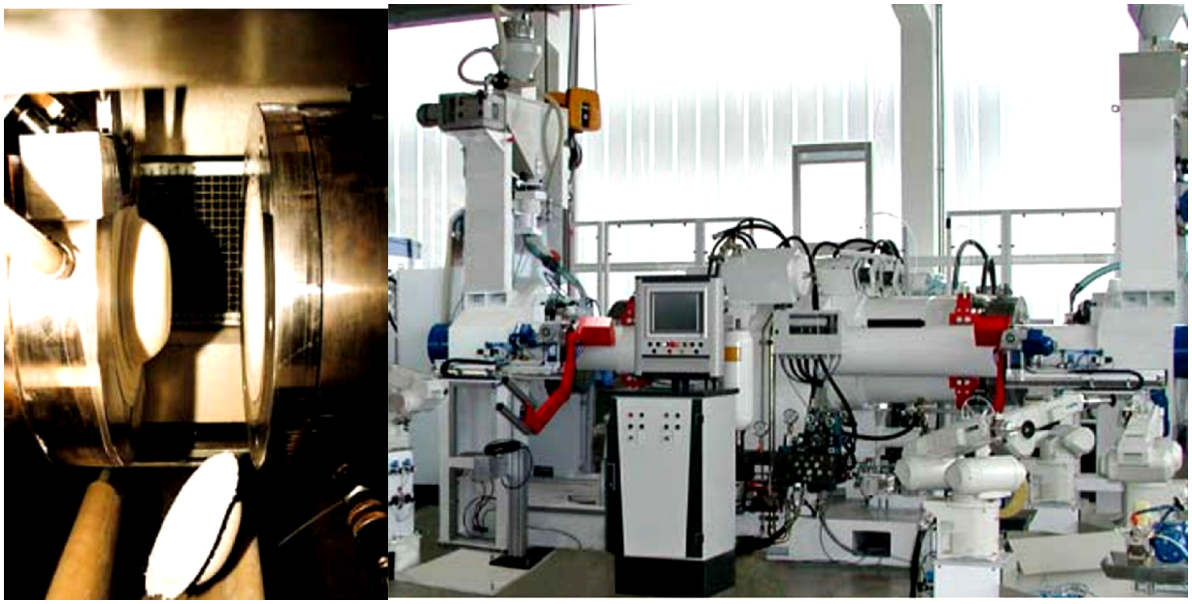


Fig. 3. Isotactic pressing of tableware

With article rim treatment machines for porcelain, stoneware, earthenware, vitreous china, bone china, round and festooned articles ,square and multi corner articles, relief and non-round articles, small and long articles from sources with a 10 cm diameter up to oval plates ca. 50 cm in diameter), flat and deep articles, including 9-15 cm deep salad bowels.

2.1.1 THE PRESS SYSTEM

Presses for green dimensions up to 225 mm, up to 375mm and 457 mm horizontally arranged, high-strength, rigid press stricter with pre- tensioned rods of special top- quality heavy duty steel.

One or two hydraulic die devices, mounted on the press traverse Completely independent control via two separate hydraulic control units (where there are two hydraulic die closing devices)

Pressure setup. differential maximum use of press capacity (where there are two hydraulic die closing devices)

Upper die and filing slide arranged on opposite cross-beams.

2.1.2 THE DIE SYSTEM

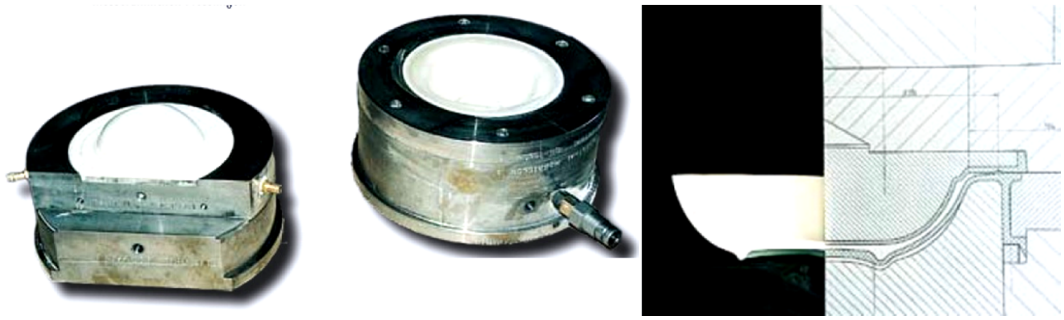


Fig. 4. The die system

CAD design precision – quality from the start

Few die construction parts –clear tool design – also highly suitable for own production

Maximum flexibility through simple and fast die change – over, longer membrane life thanks to fully isostatic compaction, eliminating the membrane wear caused by static pressure peaks. Pressing procedure causes little wear as there are no moving metal parts All die parts in contact with the body are made of polyurethane ,Ceramic granulate in the die only comes into contact with the polyurethane membranes and coatings

For bone china : optional upper steel punch to be used with special fettling devices fast movements give precise demoulding of very deep articles and controlled, careful “free fall” of pressed articles into the discharge chute , Economic die combinations through selection of die exchange sets for similar diameter and size of articles

2.1.3 THE GRANULATE FILING SYSTEM

Fluidization of the spray granulate with compressed air , Fast, constant and complete granulate feeding to the die filing space ,Reproducible volumetric filing for articles of constant weight and size Effective de-airing of the fluidized granulate

One filing slide can be used for many dies

2.1.4 SIEMENS SIMATIC PROGRAMMABLE LOGIC CONTROL UNITS

Process control and monitoring via terminal on screen adjustment of all operating parameters: timers, pressures and distance visual control of isostatic pressing process with pressing display .

Storing of all article –specific adjustment via a programmer management function

Production control through data processing: Listing of shift protocols ,Listings of down-times with causes ,Production statistics and measurement of cycle times, In the event of malfunction, diagnosis and listing of faults ,Complete on-screen operating instruction

Operator guidance with on-screen texts, And its Optional to printout of article/production check-list and remote diagnosis

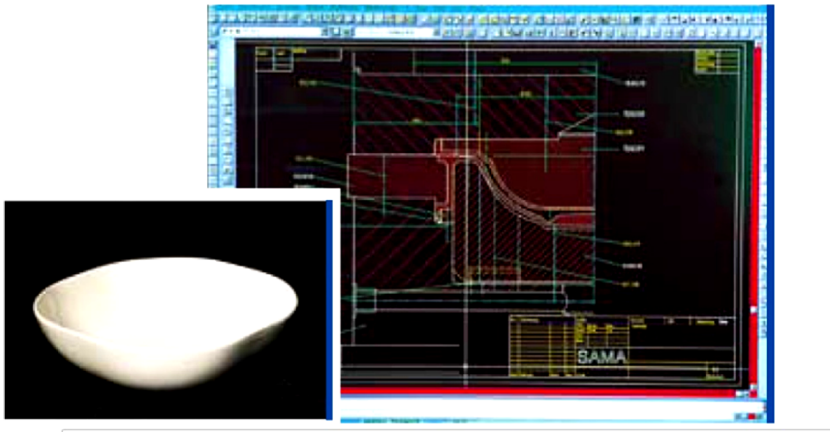


Fig. 5. programmable logic control units

2.1.5 ARTICLE RIM AND FOOT FINISHING SYSTEM

Round table systems for round, on round and oval articles with 8 spindles

Robotic for non-round special shaped articles, Combination possibilities to increase productivity e.g.: use of two indepent article rim and foot finishing system for the manufacturer's requireme

Fig. 6. foot finishing system

2.2 HIGH PRESSURE CASTING MACHINES

From slip to the cast piece, without plaster moulds,The highly flexible High Pressure Casting Process is especially suitable for the production of non-axially symmetric articles in two-part moulds, even when dealing with smaller quantities.

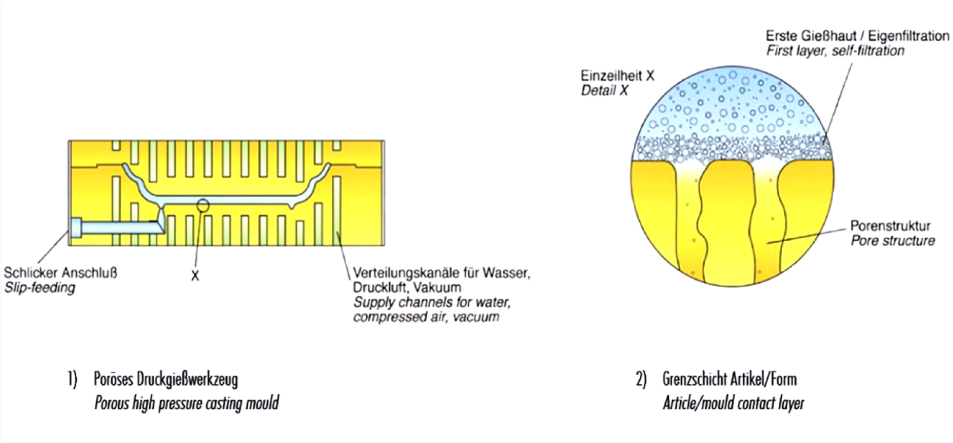
2.2.1 GENERAL HIGH PRESSURE CASTING PROCESS

1- Firstly the slip is fed into the cavity of the tightly closed porous resin mould.

2- During filling of the cavity there is a slight increase in slip pressure; a so called “first layer” is built up, which acts as a self-filtration barrier (see next figure) for further de-watering. This layer prevents small body particles penetrating the pore structure.

3- Pressure then increases (this can be done in several steps) up to the set value and is kept there until the article is fully cast

Subsequently, the slip pressure decreases and the cast piece is remolded by means of a manual suction device and the simultaneous application of compressed air to the (Usually female) mould part, Typical hpc cycles, with different curves, are illustrated in The next figure



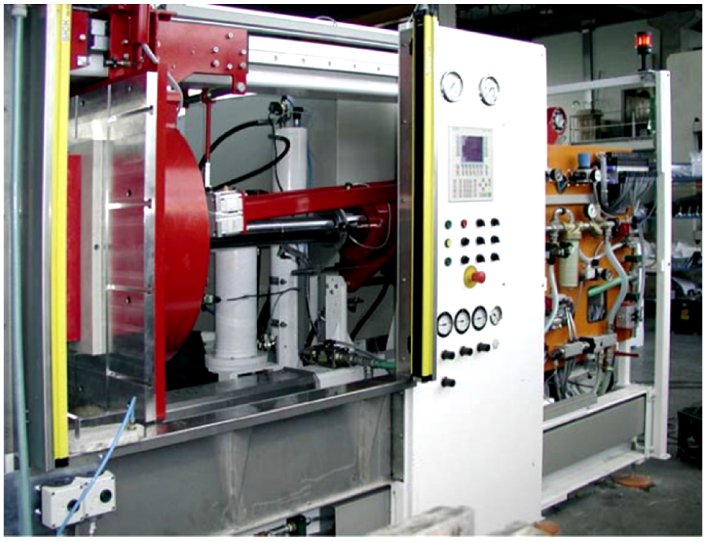


Fig. 7. High Pressure Casting Process

2.2.2 MOULD TECHNOLOGY

In addition to efficient and economic machines, mould technology and porous mould resins are additional key elements for successful high pressure casting.

When you purchase a high pressure casting machine transfers the simple and practical KNOW HOW needed for mould-making to the customer’s plant.

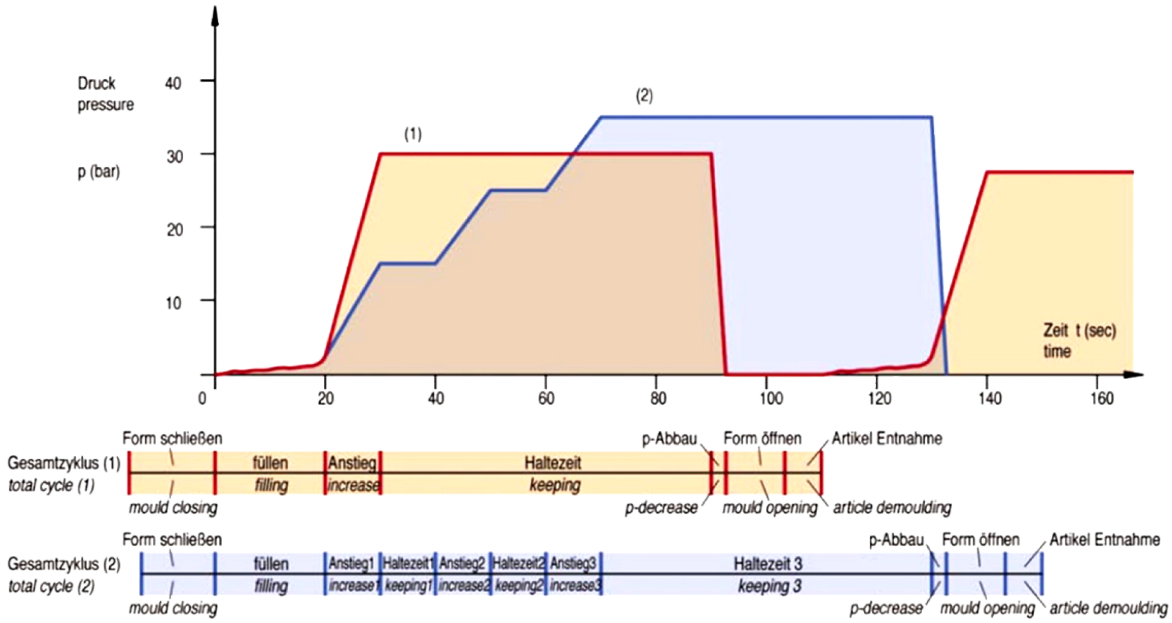


Fig. 8. Typical hpc cycle

2.2.3 ADVANTAGES OF HIGH PRESSURE CASTING PROCESS

1. Improvement in Quality
2. high class article surface
3. porous moulds resistant to wear
4. precision of contour and relief work
5. High grade dimension accuracy even after several casting.
6. constant article weight
7. less effort in fettling and sponging
8. improved handling stability, decreased sed risk of deformation.
9. decreased dependence on operator's skill

2.2.4 INCREASE IN PRODUCTIVITY

1- Highly flexible production thanks to quick mould change-over
2- Elimination of space-consuming plaster mould stocks
3- No mould drying
4- Comfortable working environment
5- Less heavy work
6- Increased output per operator
7- Decreased space requirements a mean compact production arfa
8- Simple, highly reliable machine operation
9- Easy mould Know-How and safe reproducibility
10- fully porous moulds with long working life
11- Possible integration in automated production cycles

Fig. 9. high pressure casting process

3.1 SPRAY GLAZING MACHINE FOR FLATEWARE AND HOLLOWARE

- For articles with densely-fi red or green body, if the once-fi ring process is applied. Ideal for glazing bone-china tableware and porcelain.
- The machine is provided with pre-heating, and drying booths for applying lead-free fritted glaze, The glaze which may have different additives is applied by compressed-air through binary nozzles, If once-fi red articles are glazed, their feet can be automatically provided with a wax layer to avoid cracking of the feet on the supports and wiping-off of the foot during glaze fettling , Options- Automatic loading and unloading devices for plates and saucers- additional equipment to glaze the inside of undercut hollowware- glaze recycling systems.

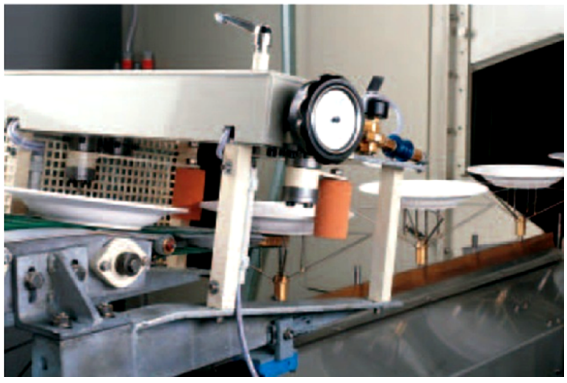


Fig. 10. Linear spray glazing machine

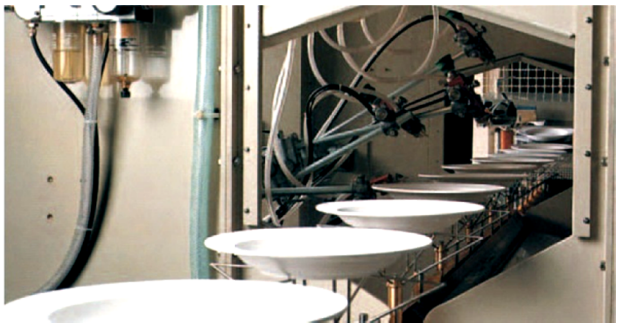


Fig. 11. automatic centering and loading of plates to the spindles of a spray Glazing line

TECHNICAL DATA

design of glazing	Bone China	Porcelain
Capacity max. (pcs/h)	2000	1500
article diameter (mm)	max. 340	360
Article height max. (mm)	150	80
article foot diameter min. (mm)	80	80
compressed-air consumption (m^3/h) - air pressure (bar/kPa)	320 - 4/4000	80 - 6/600
water consumption approx. (l/h)	1000	250
no. of spindles	148	60
installed heating capacity (gas) (kW)	250	-
waste air quantity for dust extraction (m^3/h) ---- 600	-	600
pressure loss at suction hood (mm - wg/Pa)	-	180/1800

4

4.1 DECORATION TECHNOLOGY

4.1.1 DIRECT PRINTING MACHINE

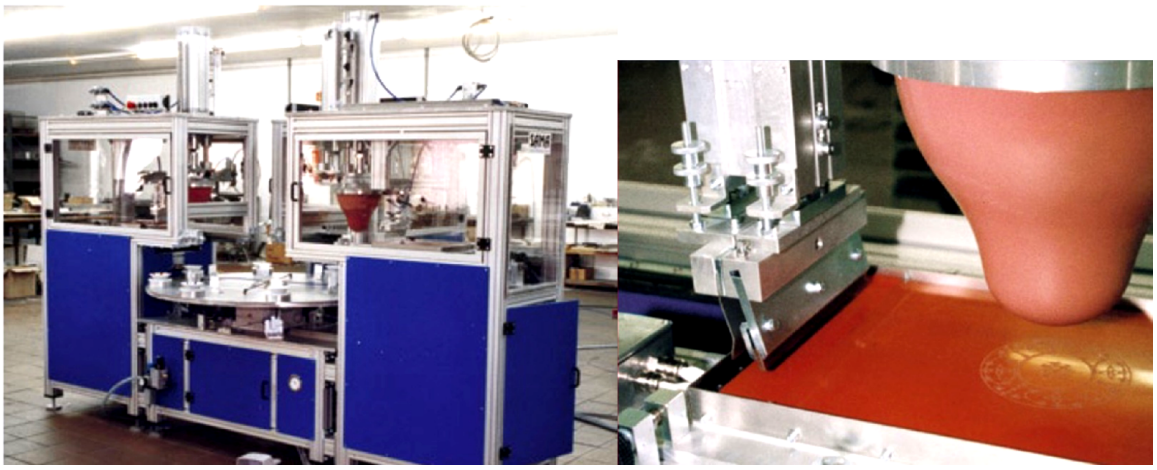


Fig. 12. DIRECT PRINTING MACHINE

- The machine is suitable for partial or full decoration of flatware items in automatic operation. It is possible to decorate porcelain in inglaze and underglaze, earthenware, vitreous china, bone china, as well as glass, enamelware and plastic articles. Printing is done with thermoplastic colours on engraved plates either of metal or plastic coated.

FUNCTIONING

The plate is placed on a centering unit, held by vacuum, and indexed exactly under the printing station. The heated engraved plate has been coated with colour by squeegee system. By lowering the printing squeegee, excess colour is squeegeed off during the movement towards the printing pad. The printing pad moves downwards, taking the colour from the engraved plate and printing it onto the article once the engraved plate has returned to ist initial position.

The printing pad returns to its initial position, the article moves to the next printing station. This procedure is repeated until all colours from the respective printing station are applied onto the article. The completely printed article is taken away

Best accuracy, very high capacity and articles of special quality are the final result.

output of the plant depending on decoration	200 - 300 Stück/h
diameter of the article	50 - 350 mm
height of the article	max. 120 mm
diameter of the decoration	max. 320 mm
air pressure	6 bar
air consumption	25 m³/h
power supply	ca. 3890 x 2540 x 2234 mm
voltage	400 V - 50 Hz - 3 Ph
space requirement	ca. 3890 x 2540 x 2234 mm
weight	2500 kg

TECHNICAL

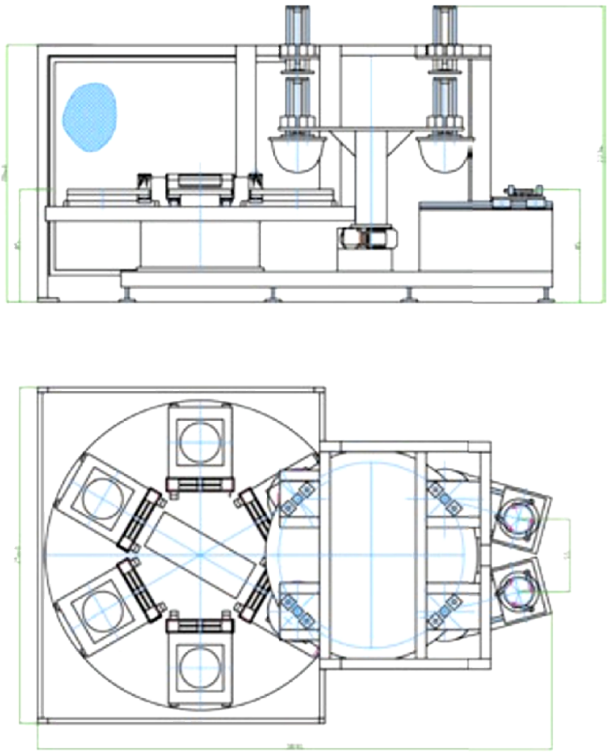


Fig. 13. DIRECT PRINTING MACHINE

4.1.2 DECAL APPLICATION MACHINE

• The machine allows the automatic transfer of thermoplastic decals onto flatware.

The decals, which are stored in a magazine, are placed onto a heated vacuum table by means of a transfer device and sucked over its entire surface.

By means of the integrated camera system, the decal is photo-optically identified in its position and moved resp., turned accordingly on the xyz coordinate table until the centre of the decal corresponds with the center of the plate.

While the vacuum table moves to the heated printing pad, the already decorated article is moved in the direction of the unloading position.

Preheated articles ensure a better and faster transfer.

• The decal application machine can, of course, also be designed as a completely automatic plant. Feeding belt for plate stacks, preheating tunnel, and tandem transfer loads resp. unloads the machine with preheated plates. After decoration, the plates can either be stacked or unloaded individually by means of the conveyor belt.

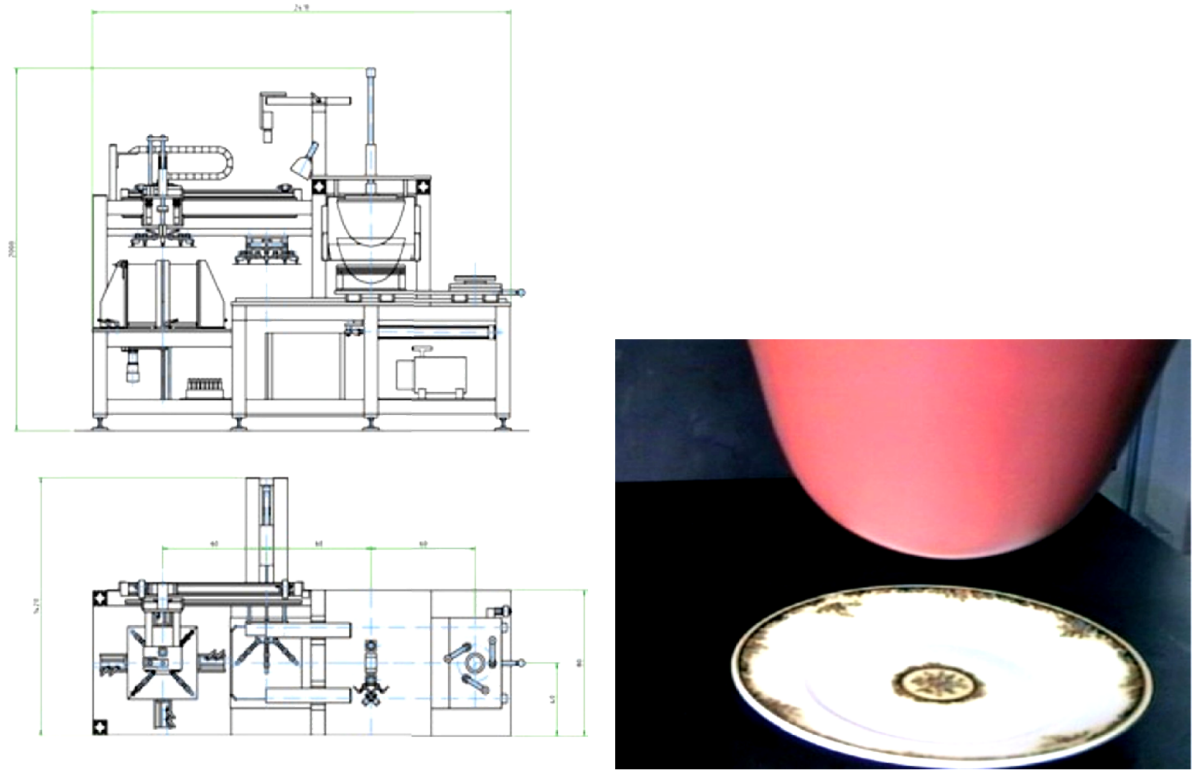


Fig. 14. DECAL APPLICATION MACHINE

LEGEND

Pos.1 conveyor belt for plate loading
Pos. 2 transfer unit
Pos. 3 conveyor belt with heating tunnel
Pos. 4 tandem-type transfer unit
Pos. 5 conveyor belt for plate unloading
Pos. 6 decal application machine
Pos. 7 switchboard

TECHNICAL DATA
output of the plant 200 - 400 Stck./h
diameter of decoration max. 320 mm
diameter of article max. 320 mm
height of article max. 120 mm
accession of air G 1/2"
air pressure 6 bar
expenditure of air ca. 6 m3/h
accession of electricity ca. 12 kW
voltage 400 V - 50 Hz - 3 Ph
weight of the plant (net) 1000 kg
decal Positioning System with
- x-y angel adjusting unit
- decal handling system
- 2 high-defi nition CCD-cameras
positioning table 400 x 400 mm
accuracy +/- 0,2 mm
measuring marks 2 Stck.(pcs.)/ø 5 mm
strokes (out of zero position) +/- 10 mm +/- 3°

4.1.3 THE BACK STAMPING:

- The back stamping machines are suitable in the porcelain and ceramic industry for the application of underglaze back stamps. Depending on the type of application, various machines are available, such as
- back stamping machine for plates
- back stamping machine for cups

FUNCTIONING

The articles are placed onto the conveying system integrated in the machine, dedusted and moved in cycles through the plant.

In the stamping position the article is centred and, thereafter, the back stamp is applied by means of pad. The pad collects the colour from the underside of the group of screens. The squeegee system, arranged over the screen, presses the colour through the screen mesh. As soon as the pad has transferred the colour to the article, it is cleaned before it collects the next layer of colour.

Fig. 15. the back stamping

TECHNICAL DATA:

ca 150 kg weight (net)
400 V - 50 Hz - 3 Ph voltages
max. 40 mm diameter of the decoration
max. 200 mm height of the article
max. 320 mm diameter of the article
6 bar air pressure
5 Nm^3/h air consumption
G 3/8" air connection
ca. 1 kW power supply
max. 1300 k/h output of the plant

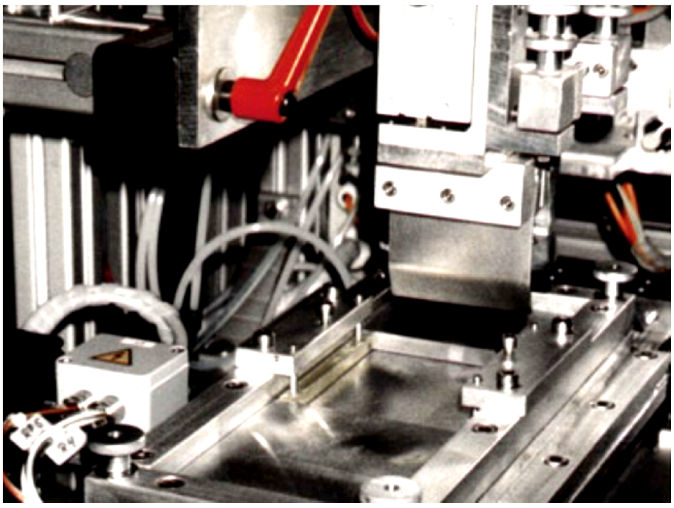


Fig. 16. the back stamping

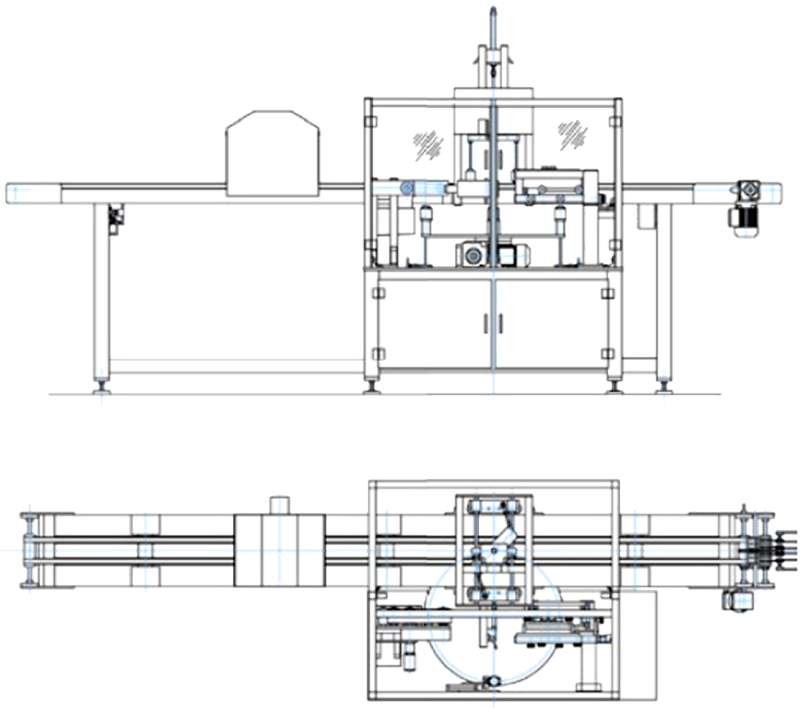


Fig. 17. the back stamping

4.1.4 BANDING AND LINING MACHINES FOR FLAT, HOLLOW AND OVAL ARTICLES

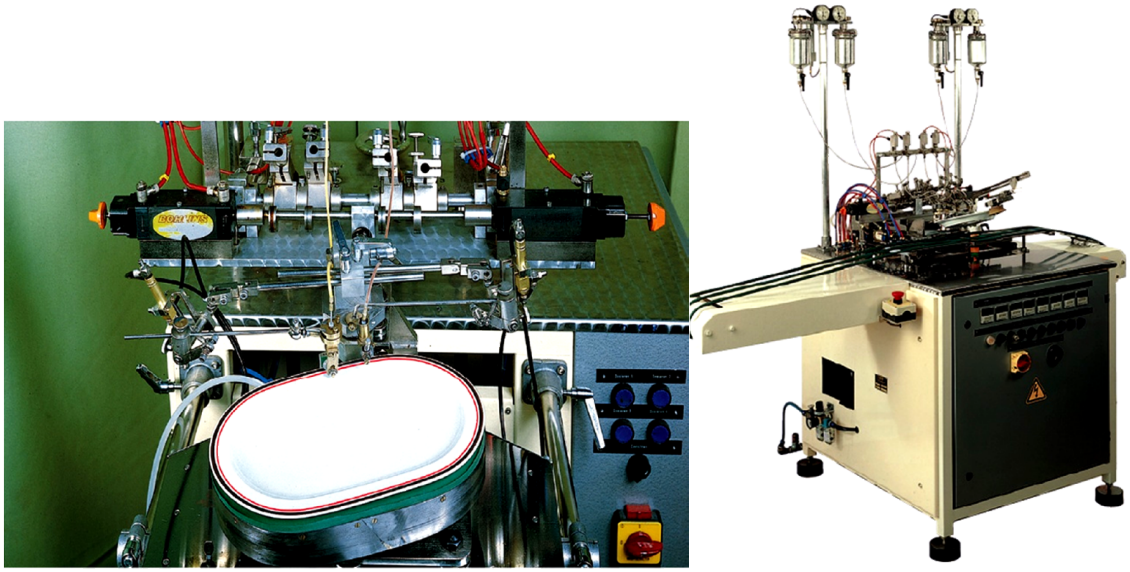


Fig. 18. Automatic banding and lining machine for flat, hollow and oval articles

• The machines are designed for automatically applying colour and gold lines or bands, rasp. Onto flat, hollow and oval articles.

• With the machines it is possible to apply four lines or bands of different colours or of the same colour in one working process onto a multitude of suitable articles The lines and bands are applied by means of lining wheels and special brushes similar to hand painting, and can be made in smooth, rustic and hand fashion. Dependent on the decoration, the width of band can be from 0.5 to 40 mm. Onglaze and underglaze decorations are possible for earthenware- vitreous china- porcelain- glass- enamelware.

OPERATION

The articles are transported on parallel running conveyer belts or manually to the lining station. The article is lifted by means of three inclined grooved rollers and put into rotation whereby it is automatically lined. Conveying speed and rotating speed are infinitely variable. If especially steep-walled articles are to be lined, it is possible to lift them up to 60 degrees (90 degrees), with the machine additionally to lower them to 20 degrees maximum. This lowering process is important above all for lining the lids in the enamelware industry.

RESULTS

1- The available modern technology of porcelain production is capable of creating a leap in quality and quantity of the industry, and eventually affects the Egyptian economy.

2- Academic material has been provided for some prototypes in stages of design. Glazing and decoration.

RECOMMENDATIONS

1- improve academic curriculums of ceramic production and design using academic material; order for the curriculum that students are taking to be aligned with technological advances.

2- To raise more awareness for the importance of the design and production of porcelain, in order to develop its study academically and industrially. Moreover it needs to not be marginalized since it has a huge impact on national economy.

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