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FEATURES AND IMPROVEMENT SOLUTIONS FOR A LENS PRODUCTION LINE

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Rezumat. *Scopul acestei lucrări este de a prezenta evoluția și procesul complet de prelucrare a unei lentile. Prin urmare, pornind de la materia primă, sticla, în lucrare va fi prezentat procesul de obținere a sticlei optice, urmată de tehnologia de procesare și de metoda de procesare a materiei prime pentru a obține o lentilă cu dioptrie corespunzătoare.*

Summary. *The present paper scope is to follow the evolution and the process of a lens. Hence, starting from the raw material, the glass, in the following pages will be presented the process to obtain the optical glass, followed by the processing technology and the method to process the raw material in order to obtain a lens with the corresponding diopter.*

Keywords: glass, optical, lens, process.

1. Introduction

The glass is the material that, when cooled, goes from liquid to solid state without any intermediate state, with the condition that both states to be in thermodynamic balance. Over two hundred types of optical glass are known. Because of the specific technoligies and special materials used, the cost of the optical glass is higher. [1]

Normal glass can be easily obtained by melting a mixture of sand, soda and chalk. After cooling dow, the mixture pass into a homogeneous, amorphous and transparent material. To obtain glasses with special technical features, the mixture will contain some new substances, like: borax, lead oxides, dolomite, inorganic dyes (metal oxides or sulphides). [1]

The most important technical variants of glass are: industrial glass, colorless optical glass, colored optical glass, light dispersing glass, technical glass, organical glass.

Production technology for optical parts is determined by the part shape and size, precision, raw material and glass type. Optical parts can be grouped into next

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catgories: lens, angles, optical wedges and plan-parallel blades. For large series production, cold processing of the parts starts from hot pressed parts, while for dedicated parts and small series it starts from blocks and plates of optical glass.

The advantage of production starting from pressed raw materials is that it avoids the initial processes to get the raw material shape as close as possible to the final part shape. Because of glass hardness, greater than hardened steel, the processing is done almost only with abrasive materials. [1]

Traditionally, the processed glass to obtain optical lens goes thorough a number of stages, listed below.

Before all, it is important to state the two types of abrasive processing of optical parts: [1]

- ✓ filing process, which is necessary to get the geometrical shape inside predefined tolerance limits;
- ✓ polishing process, which is used to obtain the transparency of active surfaces, by smoothing the roughness.

Filling tools are necessary to process the active surfaces of the optical parts, using free abrasive. Their shape can be: flat, concave or convex.

Main operations of the technological process are:

- ✓ debiting;
- ✓ gross filling;
- ✓ medium filling;
- ✓ fine filling;
- ✓ polishing.

Checking is done using spherometers or spherical gauges. Using gauges is based on light interference effect, which, depending on interference rings configuration and bending, highlights the deviation from sphericity or flatness of the checked surface, in relation to a norm.

After the fine filling, the lens surfaces are checked for:

- ➢ marks of the milling process (stings, scratches)
- ➢ scratches made by hard grains.

Next processes consist of relasing (detaching the lens from the metalic alloy can be done by immersion into hot water or mechanical shock) and washing.

Washing is done with special tools and consists of a series of steps:

1. dipping: one or two washes using a sovent (perchlorethylene) to dip the impurities on the lens surface

2. washing: ultrasound washing using washing powder – rinsing using water flow – ultrasound washing using acid washing powder
3. ultrasound rinsing - to remove the water (using a special oil, lighter than water), immersing the lens into this oil, the water drops on the lens goes to the bottom and it is later purged out
4. drying: ultrasound drying using hot perchlor – 3-4 cycles of drying under prchlor steam.

In the end, there is a two stages final check

- accuracy check and visual check of the material accordingly to STAS 10150
- power deviations check using fronticofometer, the deviations must be inside limits specified in STAS 10150.

Because of technological evolution, in our days the production process of a lens has evolved as well and most of the stages above are automated.

To highlight the actual processes used to obtain the ophtalmic lens, I have discussed with people from a lens plant in Romania. Discussions were focused on automated processes and efficiency.

Next will be presented the way to process a raw material in order to obtain a lens with specific diopter in the biggest ophtalmic lens production plant in Rhein Company.

2. Current stage

“Rhein” name was inspired by Rin river and started with the will to expand to an European market [2], [3].

“Rhein” company is not a lens plant, as most of the people say, but a lens laboratory, meaning that the lens arrive to them already processed. What they do is to generate the diopters and to apply the demanded treatments. Hence, it was chosen to discuss about the process to obtain a progressive lens “Camber freestyle”.

First step when ordering a lens depending on each one needs is the oftalmology control, which can be done in every authorized medical otpics cabinet. After the diopters are determined, the lens and frame are chosen accordingly to pacient needs. Next, the progressive lens “Camber freestyle” are ordered. The ordered is taken oafter discussing with a person from Rhein call center, by filling up a form. After that the order and technical data for processing are registered, meaning the choose of lens type: monofocal, bifocal or progressive.

Next step is to print the technical data sheet and to choose the raw material (lens without diopter but having the radius corresponding to final diopter) which can be transparent, fotochromatic (dimming) or polarized. Also, to process the lens it is important to take into account the refraction index. Raw materials are placed into a plastic tray so that the transport from an operation to another to be easier and safer.

Each technical data sheet is marked with a bar code, which is scanned every time the raw material goes through a machine and it contains next information:

- Diopter
- Lens type
- Thickness
- Radius
- Other processing technical specifications.

In the next step the lens are blocked (Fig.1), meaning that an aluminium suction cup is attached to them. This is a semi-automatic process because of the need of an operator to block the lens and to ensure that the process is correctly executed.

Fig. 1. Alloy blocker - Layoutblocker-PRA

Next stage is to generate the diopter using the VFT Orbit machine (Fig. 2). This process is fully automated and it is done using the natural diamond.

Fig. 2. Diopter generator - VFT orbit machine.

After the diopter is generated, the filling of the lens begins (Fig. 3). Here, different abrasive materials are used, each one having a different color, depending on the desired filling. When the tray with the raw material arrives at the machine, the bar code is scanned. This way, the machine knows what type of abrasive material to use, depending on the refraction index as well.

Fig. 3. Lens filler –Toro Flex machine

Then the engraving of the lens take place. This is also a fully automated process (Fig. 4). A laser will engrave the manufacturer logo, in this particular case “RV” is engraved and in the case of progressive lens some other parameters are engraved.

Fig. 4. Lens Gravor machine

Next comes the process of releasing the lens from the aluminium suction cup, using a marble circle. The process is done by an ultrasound machine.

After the lens are released, the first inspection is done. Actually this is the diopter check. If it is not correct, then the entire process is done again. The inspection is done by an operator. If the diopter is correct, then the hardening of the lens is done (Fig. 5). This is done by applying a layer of varnish which differ from one refraction index to another and it takes from 2 to 6 hours.

Fig. 5. Lens hardening.

After hardening, the varnish layer is dried by placing the lens into a sealed oven for 2 to 6 hours (Fig. 6).

Fig. 6. Drying oven.

Next, the lens are moved into a queue oven, until the AR (antireflection) machine is free. This process will take from 2 to 4 hours, depending on the number of AR layers applied (Fig. 7). When the hardening varnish is fully dried, an operator check the lens once more time to ensure there are no impurities or other marks.

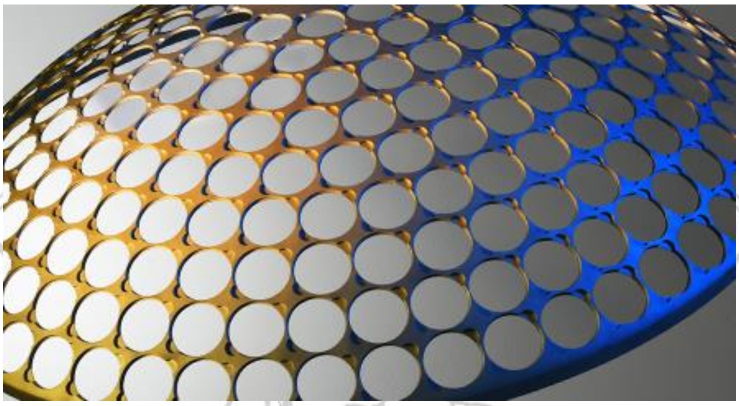

Fig. 7. Applying AR.

Final control is also done manually by an operator and next aspects must be accomplished:

- esthetic- there are no impurities
- technical characteristics: thickness and tolerances correspond to the values from technical data sheet
- color.

Last step is to mark the lens with the specific marks for a progressive lens. These marks will help to mount the lens on the frame accordingly to individual measurements from the technical data sheet written in the prescription: distance area, medium area and close area.

3. Conclusion

During this study, the processing stages for a lens were detailed, including knowledge of the technological process, starting from the glass composition, processing stages and the materials used, including the manipulation of the final product.

The study shows the processes involved into making a progressive lens. A good improvement for these lens is related to specific marks on the lens, meaning the distance, medium and close areas, which helps when mounting the lens on the frame, not to be done using paint. The wax would be more efficient because it is easier to remove and can not cause any scratch.

Another improvement, for any lens, could be implemented at the final check of the lens by the operator. It is about a black panel for a better and safer check of the surface smoothness.

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