GRINDING OF CONICAL SURFACES OF LIGHTING COLUMNS WITH ABRASIVE TOOLS

Szlifowanie powierzchni stożkowych słupów oświetleniowych narzędziami nasypowymi

Шлифовка конических поверхностей светильных колонок абразивным инструментом

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Abstract: In this paper, the methods for grinding conical surfaces of lighting columns were presented. The operation aims to improve the surface quality of the column and prepare it for the application of a varnish layer. The article describes the methods of grinding with embankment tools using leaf blades and endless straps. The characteristics of the methods and the devices that are used to carry out the process are described. Conclusions on improving work efficiency and safety were presented.
Keywords: grinding, lighting poles, embankment tools, leaf blades, endless tapes

Streszczenie: Artykuł przedstawia metody szlifowania powierzchni stożkowych na przykładzie procesu powstawania słupów oświetleniowych. Scharakteryzowano metody szlifowania materiałami nasypowymi z zastosowaniem tarcz listkowych oraz taśm bezkońcowych. Opisano charakterystykę metod oraz przedstawiono urządzenia, które są wykorzystywane do szlifowania słupów oświetleniowych. Opracowano wnioski dotyczące poprawy wydajności oraz bezpieczeństwa pracy.
Słowa kluczowe: szlifowanie, słupy oświetleniowe, materiały nasypowe, tarcze listkowe, taśmy bezkońcowe

Introduction

Manufacturing process of lighting columns made of cone shaped aluminum tubes requires a number of technological operations. One of these operations is shaping a pipe on a special machine that combines two technological treatments, such as rolling and drawing. The semi-finished column to be processed is an aluminum pipe with a suitable composition and a specific hardness. After the rolling process, a pipe with a cone outline is obtained. A lot of surface defects arise on the surface of the processed column as a result of the contact between the rollers of the rolling mill and the workpiece. They mainly result from the distribution of forces, material stresses and friction phenomena that accompany the rolling process. These defects have no major impact on the strength of the post, but on the visual effect of the finished product. The defects in question relate only to the external surface. In order to improve the visual quality of the surface and prepare it for the painting operation, the surface is subjected to a grinding operation. Grinding can be carried out using various abrasive tools.

The discussed methods in this study concern the use of bulk tools and are implemented on special machine tools. The conclusions presented in the paper refer to the advantages and disadvantages associated with the grinding methods discussed.

Grinding columns with lattle blades

One of the well-known methods of abrasive machining is the abrasive tools in the form of flap discs. The process of grinding with abrasive web discs is a type of surface rim whose task is to give the machined surface a given roughness by machining, without any significant change in shape. Blade discs, which are used for grinding, are characterized by very high flexibility, which is why they have found application in grinding objects with simple and very complex shapes. They are used for machining elements made of aluminum, stainless steels, acid-resistant steels, brass, constructional steel, or more and more often in the processing of plastics.

The blades are intended for both face and circumferential grinding. Under the influence of centrifugal force, the blade leaves are in contact and affect the machined surface by changing the rotational speed ns and pressing force F (Fig. 1).

Blade discs belong to the group of coated abrasive products due to their structure (Fig. 2). The nonwoven substrate is made of non-woven synthetic fibers, with a predominance of polyamides, which are characterized by high resilience of deformations. Thanks to the use of high-strength resins (binders), small abrasive particles are attached to the fiber. The most commonly used are silicon carbide or silicon carbides. The distribution of abrasive

Fig. 1 Grinding with a flap disc: a) peripheral, b) front [8]
Rys. 1. Szlifowanie tarczą listkową: a) obwodowe, b) czołowe [8]

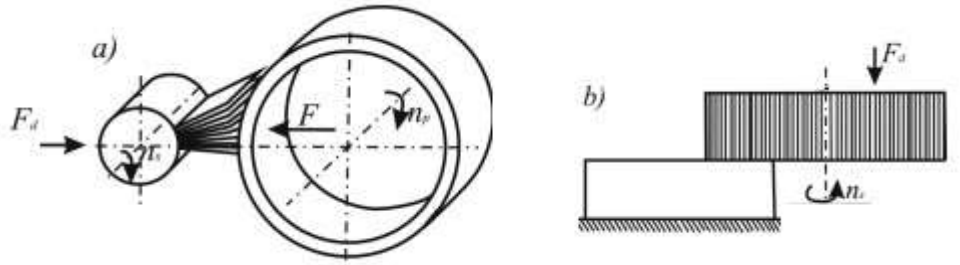
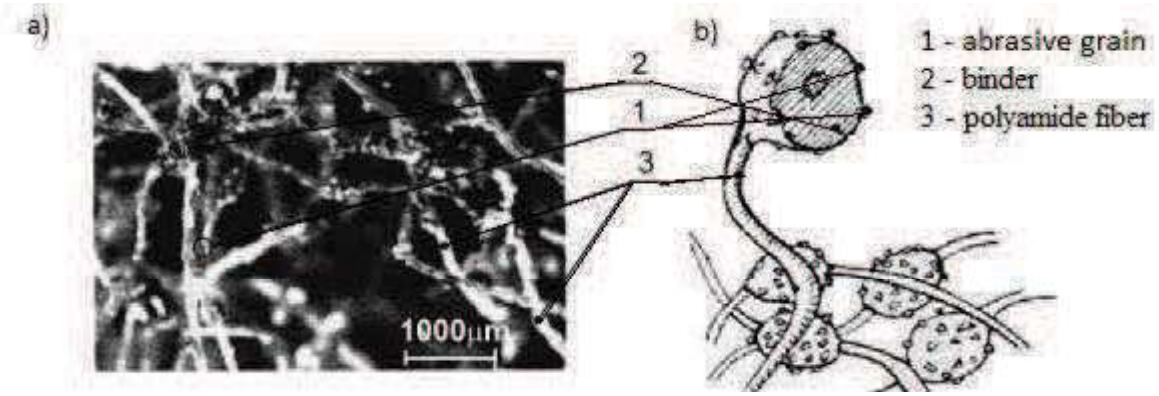


Fig. 2. Structure of the abrasive non-woven fabric: a) microscope photo, magnification: x15; b) abrasive non-woven model [8]
Rys. 2. Struktura włókniny ściernej: a) zdjęcie mikroskopowe, pow. 15×; b) model włókniny ściernej [8]



particles is chaotic, but occurs on the entire surface, thus creating a relatively homogeneous structure. Uneven distribution is very important during grinding operations. The blade disc must have a suitably shaped body.

Non-woven abrasive has many advantages. Through uniform distribution of the grains, a homogeneous structure is created that allows to maintain constant invariable working conditions. The fiber bonds provide heat dissipation - ventilation, which is very good conditions in the cutting zone, preventing overheating of the surface layer. In addition, fine dirt is picked up from the treated surface, which causes the process to be carried out by a "clean" non-woven fabric. Thanks to the very good flexibility, the blade leaves adapt to the shape of the workpiece. Blade discs are safe to use and are suitable for automated processes, therefore they are increasingly used as part of abrasive devices for special applications.

The characteristics of the grinding disc process are based on intermittent cutting and constant renewal of the grains in contact with the workpiece, in relation to their wear, dulling or breaking out of the abrasive fleece. The main feature of the abrasive web disks is to obtain a homogeneous geometrical structure on the surface of the workpiece. At the same time removing all kinds of burrs, sharp edges do not cause deterioration of shape and dimensions.

Blade discs were also used in the process of grinding aluminum lighting poles to remove surface defects after the rolling process. The machining is carried out in a special position. This device sets the workpiece which is the lighting pole in a rotary motion. In parallel to the axis of the workpiece, a working part is attached, which includes a drive unit with a head for mounting disc blades. An overview photo of the position is shown in Fig. 3.

The disadvantage of this solution is relatively expensive purchase of leaf blades and their short exploitation. In addition, the aluminum grinding process produces aluminum dust in large quantities, which is very dangerous. Aluminum dust may burn out or ignite, causing a fire hazard. Another disadvantage is the employee aspect related to the exposure of employees to harmful chemical and physical agents at the workplace.

The process of grinding poles with the help of leaf discs on the presented stand is a non-economical

Fig. 3. Stand for cleaning lighting columns with disc blades
Rys. 3. Stanowisko do czyszczenia słupów oświetleniowych tarczami listkowymi

process, inefficient and creating a threat of aluminum dust explosion. For this reason, the idea of creating a new workstation was born, which eliminates the above-mentioned disadvantages and increases productivity and comfort of work. This applies to machining with abrasive belts.

Grinding columns with endless tapes

Abrasive belts belong to the group of coated abrasive tools. They have the largest production applications in the industry due to the way they are made. They are made to the desired width and length by punching on special machines from rolled abrasive products. The pre-cut ends are joined and glued according to a specially developed technology. One can distinguish tapes with one-layer, multilayer and spatial embankments. They are mainly made of electrocorund and silicon carbides. Due to the method of application, tapes with abrasive applied by gravitation or in the electrostatic field can be distinguished. According to the purpose of the tape, it is divided into: full (closed) embankment 100% surface coverage, semi-open embankment 70-90% coverage and sparse (open) embankment with a coverage of 50-70% of the surface grains. Another division of the tapes that can be distinguished in terms of the connection of the ends of the tape is an overlapping (impact) connection or a contact joint (without impact). The strip joint is a critical zone, because the connection results in the interruption of the uniformity of the abrasive applied. By standards and standards, the tensile strength at the joint should not be less than the strength of a solid abrasive belt. In fact, the strength of the joint (suture) determines the strength of the entire belt. In practice, it applies equal types of connectors (Fig. 4).

The most commonly used are tapes with standard overlap joints. With the width of the strip smaller or equal to the width of the abrasive roll, endless bands are sewn with the seam at an angle (45-65°). In the case of a width greater than the width of the roll, the seam is used at an angle (5-65o). The standards also specify the thickness and width of the seam. The width cannot exceed 15 mm. For the thickness for P8-P120 granulation

Fig. 4. Types of connections of endless abrasive tapes [4]
Rys. 4. Rodzaje połączeń taśm ściernych bezkońcowych [4

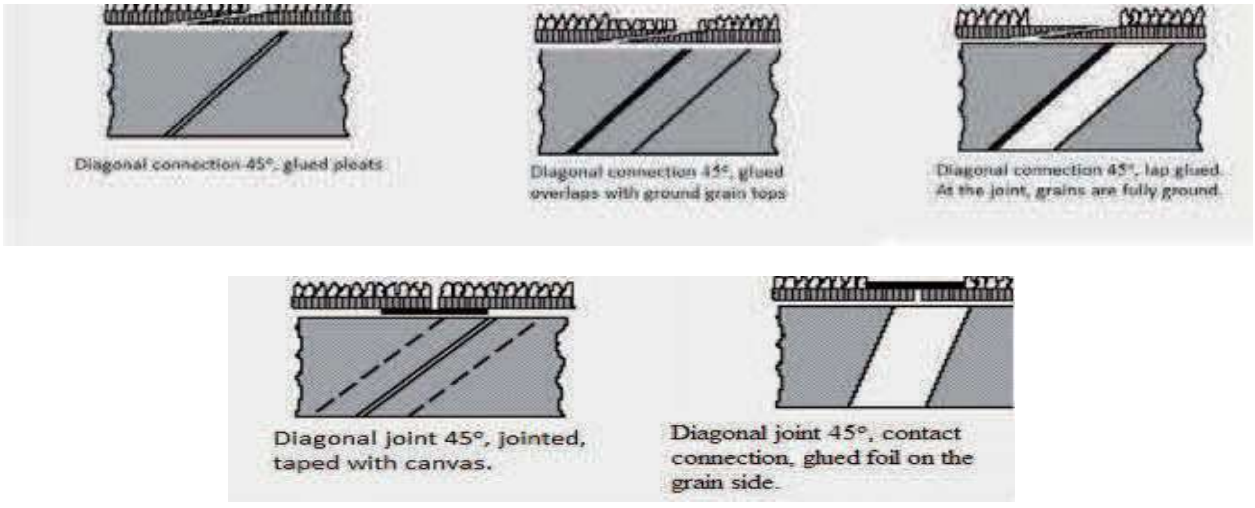
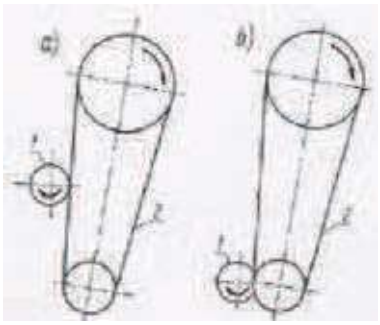


Fig. 5. Grinding with an endless belt a) free, b) support [9]
Rys. 5 Szlifowanie taśmą bezkońcową a) swobodne, b) podporowe [9]



should be less than 0,05-0,1 mm. For the granulation> P150 allows a seam thickness greater by 0.1mm than the thickness of the tape. All overlapping tapes must work in a specific direction in accordance with the mark on the ground (directional arrow). In practice, in the case of manual processing, tapes not exceeding 80 mm wide are used, while for mechanized machining, this width may in extreme cases amount to as much as 1500 mm. The width of the tapes and their length are selected depending on the shape of the workpiece, the possibilities of the machine tool and the method of tightening the belt.

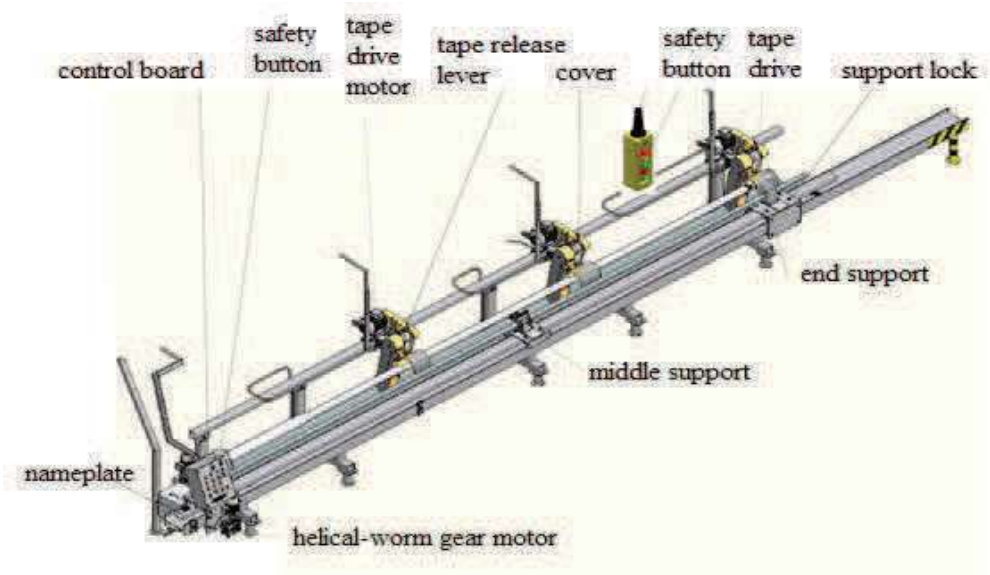
In order to make optimum use of the abrasive endless band, it is necessary to pay attention to the right type of abrasive grain, as well as the binder and substrate. Endless belts are widely used in the industry for grinding and polishing surfaces of workpieces made of metals, wood, glass, rubber, plastics and even concrete. They are also often used to clean surfaces from rust, varnish, etc.

Characteristics of the grinding process with abrasive belt always rests on the driving roller, which often also serves as a supporting element and on a loose roller. Loose roller is used to guide and tension the tape. If the machining is carried out on a part of the tape pressed by the disc (Fig. 5b), then the machining parameters are similar to the grinding wheels. Often, treatment is also applied to parts of the free tape (Fig. 5a).

One of the main parameters of the treatment is the determination of appropriate support and pressure elements, because their application, appropriate shape and size have a significant impact on the efficiency of the tool (endless belt), as well as on the efficiency of the entire grinding process. The pressure element and the processing site are of great importance in the grinding process. Their significance differs depending on the kinematic schemes of machine tools. If you do not use pressure elements when processing with an endless band, and you get the right tension of the tape, we get very large possibilities of surface treatment with a complicated shape.

The use of endless belts in the process of grinding light poles solves problems related to the economy and process safety, which have been described earlier. The implementation of the process requires a special machine tool, the construction scheme of which is shown in Fig. 6. The machine has a supporting frame on which three independent cleaning heads are mounted. Each head has interchangeable abrasive tapes that are water-cooled. Thanks to such application, the problem of pollination during machining was solved. The workpiece, which is a cone shaped lighting tower, is mounted on the machine supports. One of the supports is a driving support that puts the pole in a rotating motion. In parallel to the axis of the workpiece, three heads are positioned at the correct

Fig. 6. Diagram of a column grinding machine using endless belts.
Rys. 6 Schemat maszyny do szlifowania słupów za pomocą taśm bezkońcowych



distance and equipped with endless belts that perform grinding. Due to the appropriate selection of rotational speed, feed and the appropriate pressure, grinding/polishing of cylindrical or conical surfaces is performed.

Thanks to the use of endless abrasive belts for grinding elements with variable geometry, which is the lighting column, the efficiency of machining is increased by better matching (alignment) of belts to the workpiece. The use of three independent heads significantly improves the efficiency of the process. However, due to the water cooling solution, the pollination to the minimum is limited, which improves the working conditions for operators. An important aspect is also the purchase of consumables such as endless belts, which are 3x cheaper compared to flap discs and the service life is higher.

Conclusions

Methods of abrasive processing with bulk materials are still at the stage of intensive development. The pressure of manufacturers of abrasives exerts an influence on the improvement of products and their parameters. New materials, machine tool and component construction, and abrasive tool constructions create new possibilities for manufacturing processes. Continuous improvement and introduction of new products has contributed to the increasingly popular use of grinding using an endless belt. Grinding with this method for a long time was mainly used for finishing of elements made of wood and wood-like materials. The next phase of development of this technology was its application to treatments such as blunt sharp edges, grinding of risers and various types of flash. Currently, the most popular use of endless belts is finishing / polishing of steel, aluminum, stainless steel and acid resistant steel.

As a result of the combination of both grinding methods, it can be concluded that the use of endless abrasives for grinding light poles is a better technology solution. The superiority of this method is to better match and adhere belts to workpieces that have the shape of a cone. The use of tapes also has a positive effect on the economic aspect associated with the purchase and the lifetime of the tools.

Presented methods of grinding conical surfaces served the idea of creating a new station - a machine for grinding conical surfaces of aluminum lighting poles with embossed tools. This project will meet the requirements regarding both the correctness of the implementation of the treatment process and the principles of work safety. The performed position will allow to conduct research on the impact of selected abrasive machining parameters on the quality and efficiency of machining. Obtained results of tests in the process of grinding conical surfaces with bulk materials at the created stand will serve as a verification of the adopted assumptions and results obtained on the theoretical path.

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