

METHODOLOGY OF CONSTRUCTION AND PRODUCTION OF TECHNICAL EQUIPMENT FOR PREPARATION OF PAPER MASS BY APPLICATION OF SOFTWARES PRO ENGINEER AND POWER MILL

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Abstract: In this work has been described methodology of projecting 3-D models of cutting elements for preparation of paper mass by application of software Pro Engineer. The projection is related with 3-D modeling of plates and conical cutting elements, and of appropriate tools which are used in final technology of preparation of paper mass. Also, there has been described application of software Power Mill for creation of path of cutting tool for production of elements mentioned above on modern CNC milling machines.

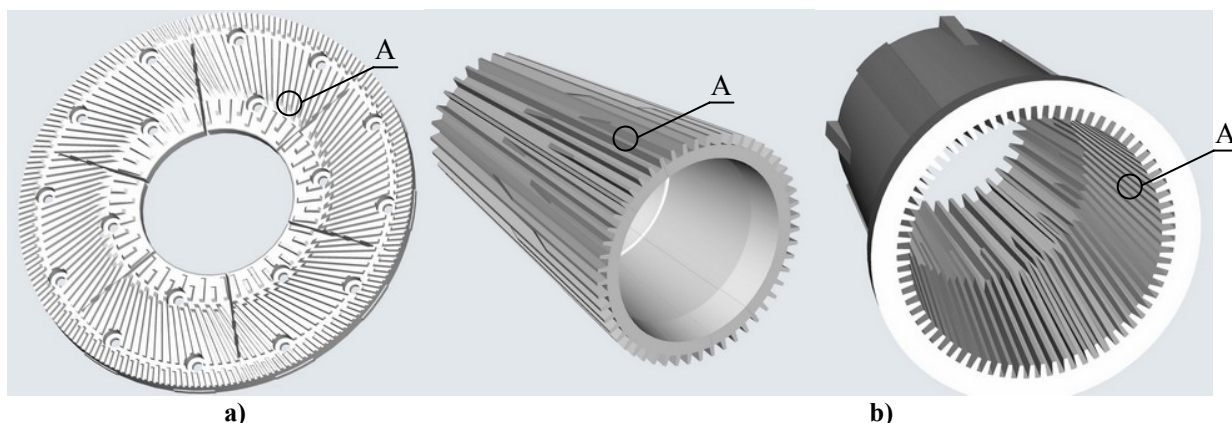
Keywords: cutting elements, konical knives; Pro Engineer, Power Mill

1. INTRODUCTION

Having in mind that today's world's paper industry, and particularly ours, has great problems with shortage of proper raw materials, specially cellulose fibres for production of paper, we have to pay attention for supply of secondary raw materials where significant place take waste paper and plant fibres.

This strategy in technology of preparation of paper mass (pulp) demands special and various technical equipment for providing adjustable conditions for proper structure of raw material. Special attention is given to development of cutting elements (tools) for preparation of paper mass, whose cutting geometry and technical parametres of preparation of "pulp" depends from source of cellulose fibres.

In scope of cutting elements, significant place take plate and conical knives (figure 1). Today, in process of construction of these technical equipment, special place take softwares for parameter 3D modelling as Pro Engineer, Catia, Solid Works, Autodesk Inventor etc, and in process of production: Pro Engineer, Power Mill, Master Cam, etc.



a) Figure 1. Cutting elements for preparation of paper mass ("pulp"):
 a) disk of plate knives 26'' "Matroz" - Sremska Mitrovica
 b) rotor and of conical knives 2R of company "Božo Tomić" – Čačak

2. METHODOLOGY OF PROJECTING CONICAL KNIVES

Parts with complex geometry which are produced by casting in sand, such as rotor and stator of conical knives (figure 1-b) have to be projected by application of CAD / CAM technology. It is necessary to make a core with several segments (9) for the stator of conical knife which has very specific inside cutting surface (figure 1-b, detail A).

Because of the specific position of cutting surface, segments can't be connected by plate surfaces, but twisted broken surfaces. Such complex geometry of segments for production of mold for core demands very complex molds (parts of mold which form core), which must provide very good compression of sand, and releasing of segments from mold without damages. That's why mold for shaping inside (cutting) surface must be made of five elements, which are connected with wedges (figure 2 and 3) what enables easy disassembling of mold and removing the element from mold.

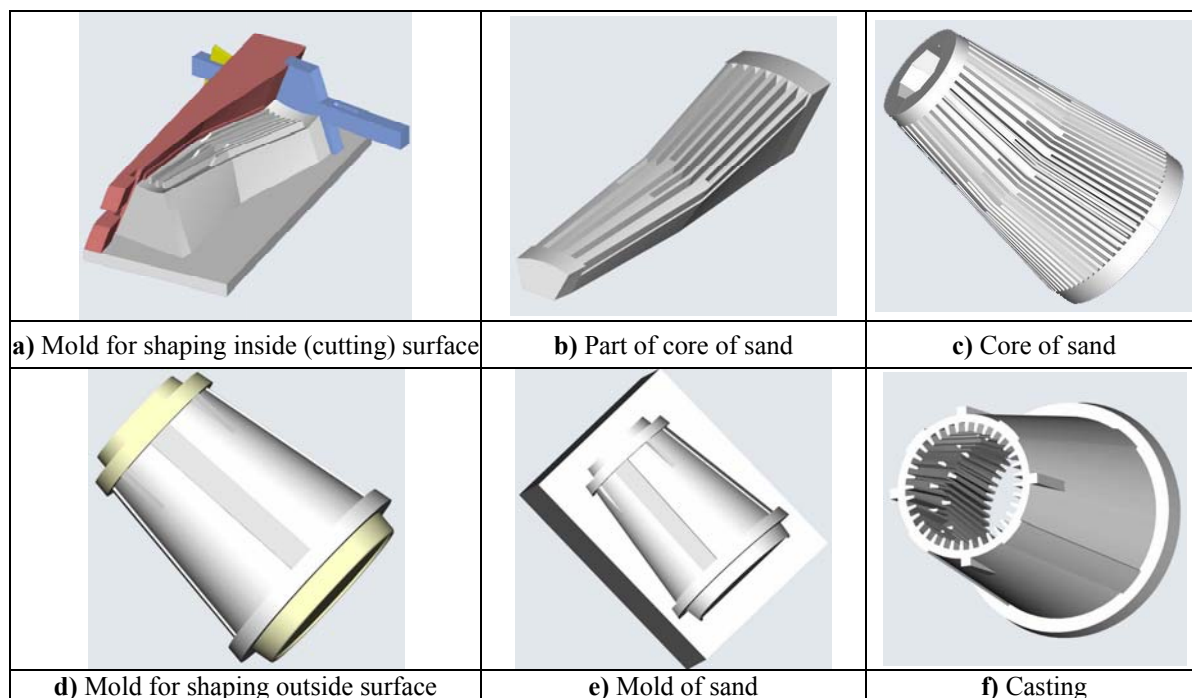


Figure 2. Stator

Because of complex geometry of each part, phase of projecting is very alleviated with application of software Pro Engineer, because there is a possibility to complete 3-D models of elements into totality (fit) to do the analysis of overlap, and to remove all the defects on models of elements. Here comes out the expression of application of parameter modelling where all the changes which are made on elements, are automatically generated on all fits and all the other elements which come out from them (parts of molds, etc.), what reduces time necessary for projecting phase. All technical documentation is assembled by forming technical drawings from existing 3-D models.

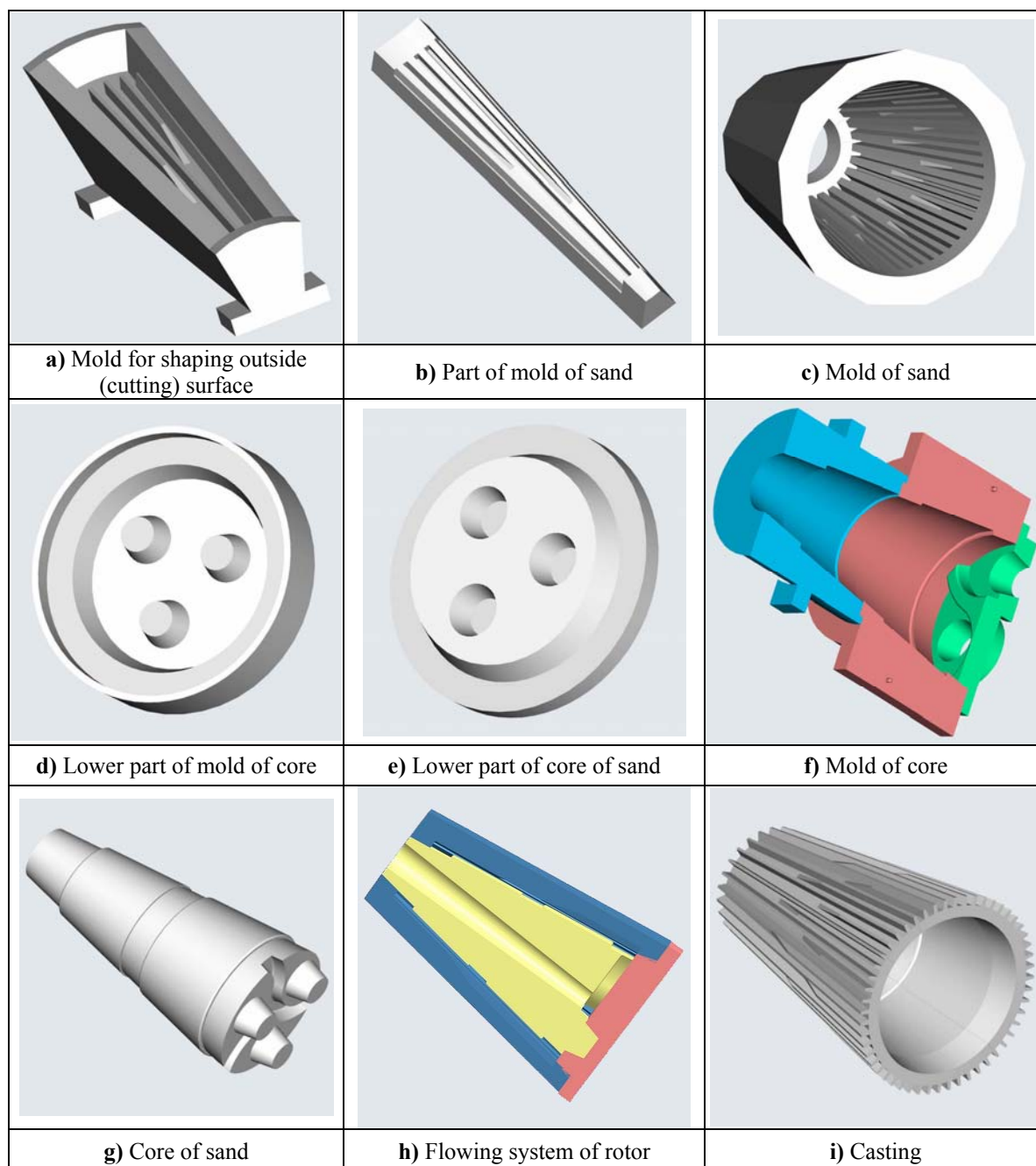


Figure 3. Rotor

3. PRODUCTION OF COMPLEX PARTS OF MOLDS

For production of elements of molds with very complex geometry as part of mold for production of segment of stator's core (figure 4-9) it is necessary to apply modern CNC milling machines, because production of these elements on custom machines, if it would be possible at all, would require very longlasting process.

Though Pro Engineer has mold for CNC processing (NC manufacturing), for creating path of milling tool for production of mentioned element was used software Power Mill specialised for CNC milling machines. Creating of path of milling tool was done, depending on geometry of final piece and of the mold (figure 4), by choosing parameters of processing (selection of tools, treatment, way of penetrating tool into material, strategy of cutting, etc.). Some phases of production of wanted element are given on figure 5-9.

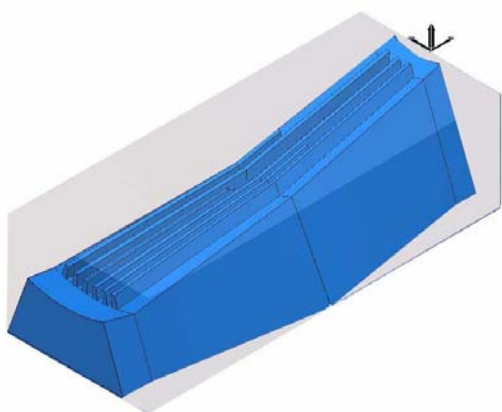


Figure 4. Appearance of final product with raw material



Figure 5. Appearance of raw material after rough machining

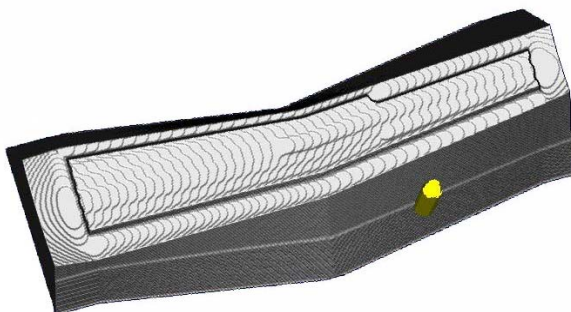


Figure 6. Fine machining of lateral surfaces

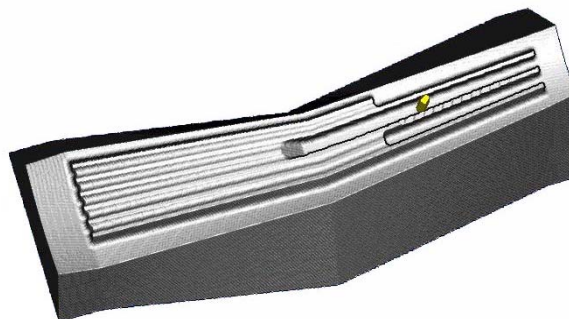


Figure 7. Fine machining of cutting surface – milling cutter R3

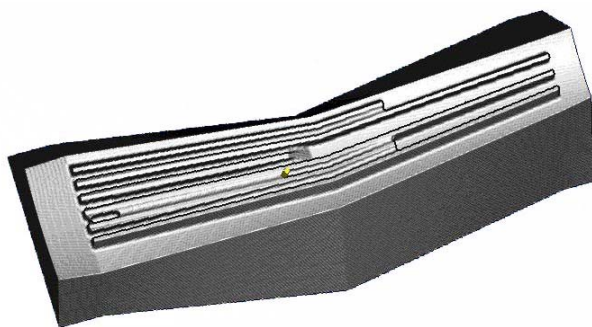


Figure 8. Fine machining of cutting surface – milling cutter R2

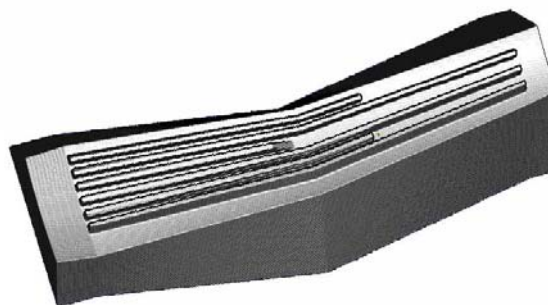


Figure 9. Final product

4. CONCLUSION

Projecting of molds with CAD softwares result in quick generating models of elements and documentation (drawings), and quick changes of models thanking to application of parameter modelling. Informations which are received from these models, such as weight, center of mass, momentum of final products, precise distance between elements of mold, clearances in mold and complete visualisation, facilitate and improve process of projecting molds, while appearance of errors is very reduced. When models are produced once, it is possible to use them in simulations of casting and testing by method of final elements (CAE), and it is possible to create paths of cutting tools (CAM) for production of complex elements on CNC machines.

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