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Investigate the Possibility of Tekcast Methods Used for Casting Polymeric Resin Materials

H. Mäsiar*, L. Repka, P. Lipták, O. Híreš
Trenčianska univerzita Alexandra Dubčeka v Trenčíne, Pri parku 19, 911 06 Trenčín, Slovakia
*Corresponding author. E-mail address: harold.masiar@tnuni.sk

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Abstract

Contribution gives an overview of knowledge about the method of centrifugal casting with orientate on Tekcast system. Company Tekcast Industries has developed a device for centrifugal casting, extending the area of production of castings or prototyping of metal or plastic. Materials suitable for the centrifugal casting with flexible operating parameters may include non-ferrous metal alloy based on zinc or aluminum or non-metallic materials such as polyester resins, polyurethane resins, epoxy resins, waxes and the like. The casting process is particularly suitable for a wide range of commercial castings and decorative objects.

Keywords: Silicone mold, Model, Vulcanization, Centrifugal force, Cast

1. Introduction

Centrifugal casting method Tekcast technology is suitable for the production of prototypes and test runs in all industries. Within a few hours, at low cost can be obtained dozens of castings to verify functionality, load and appearance. It is possible the continued implementation of the required changes without costly additional adjustments. [1]

2. Method TEKCAST

Tekcast method is a technology that uses centrifugal force to fill the mold cavity molten metal. It is a method of imitative centrifugal casting

Applying all the advantages of centrifugal casting, this method is a tool that fully meets the requirements of registration as functional as well as decorative items. This technology of imitative centrifugal casting (Fig. 1) is not only fast, but also cheap. Exclusively for this technology was developed TEKSIL material - silicone rubber for mold. Material forms provides high precision casting, high precision detail and relatively long life forms. Castings are dimensionally accurate, clean and they have high quality of surface, with minimum requirements for further processing.

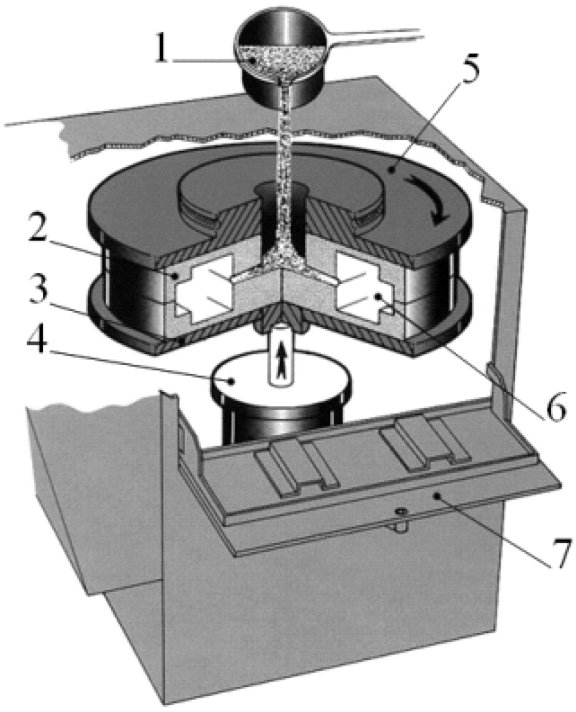

Fig. 1. Scheme of the process of centrifugal casting method Tekcast [3], 1 - molten metal or plastic in a liquid state, 2 - silicone form 3 - bottom plate, 4 - air cylinder, 5 - top plate, 6 –shave of mold cavity, 7 - door

3. Characteristics of materials used for making molds

Company Tekcast Industries Inc. Has developed a range of materials suitable for the production of high-temperature-resistant rubber molds for casting. All these materials for making molds are classified into three basic groups:

– Silicone rubber (TEKSIL),
– Organic rubber,
– RTV material.

Material forms are chosen with respect to the requirements for their use, such as cast material, pouring temperature, the required dimensional accuracy, design complexity of forms and life forms.

In Table. 1 shows the different types of materials, forms and their use according to the type of material cast castings.

Table 1.
Application of two types of materials of forms depending on the material of castings[2]

	Zinc alloy	Alloy of tin and lead	Plastics	Thin-walled al. castings
White TEKSIL (DW)		X	X	
Gray TEKSIL	X	X	X	
Brown TEKSIL	X	X	X	
White TEKSIL (HT – 1M)	X	X	X	X
Red TEKSIL	X	X	X	
Blue TEKSIL	X	X	X	
Red TEKSIL		X	X	
Black rubber		X		
Black rubber		X		
Black rubber		X		
Black rubber		X		
Black rubber		X		
White rubber		X		
RTV	X	X	X	

X – possibility of form material application for the selected type of cast materials

4. Polymeric resins as casting materials

For this experiment were selected two-component polyurethane casting materials - resins. Casting resins comprise two main components:

- Component A - resin (Polyol)
- Component B - hardener (Isocyanate), delivered in a predetermined mixing ratio. Mixing the components starts an exothermic reaction in which within a very short time (several minutes) and the mixture hardens within a few hours it is completely cured.
- **Polyurethane resin F 16**

From selected two-component casting materials it was used Polyurethane resin F 16.

Table 2.
Physical properties of fast curing polyurethane resin F 16

	F 16 Komp. A	F 16 Komp. B	Without filler	With filler RZ 30150
Composition	(Polyol) resin	(Izokyanát) hardener		
Color	White	amber	beige	beige
Mixing ratio	100	100	-	300
Viscosity at 25 ° C [MPa.s]	90	55	80	1500
Densiti at 25°C [g/cm^3]	1±0,02	1,1±0,02		
Density at 23°C [g/cm^3]			1,5±0,02	1,61±0, 02
Processing time at 20°C on 200 g [min]			2÷2,5	3÷3,5

- use: in the manufacture of thin-walled castings (adding the filler based on aluminum), the production of castings with thicker walls (adding the mineral-based filler),
- Process of dispensing, mixing and casting components was suitable for small batch hand casting
- material properties: low viscosity, short curing time, small shrinkage, temperature resistance 100 ° C

- **Polyurethane resin SG 140/PUR12**

From selected two-component casting materials it was further used Polyurethane SG 140/PUR12

Table 3.
Physical properties of polyurethane resin SG 140/PUR 12

	SG 140 Komp. A	PUR 12 Komp. B	Mixture SG 140/PUR 12
Composition	resin	hardener	
Color	white	brown	beige
Mixing ratio [g]	100	100	
Viscosity at 25 ° C [MPa.s]	165±30	60±5	70±10
Densiti at 20°C [g/cm^3]	1,00±0,02	1,10±0,02	1,05±0,02
Density of the cured product at 20°C [g/cm^3]			4 - 15
Curing at room temperature [min]			30 - 60

- moderately fast curing, impact-tough casting material
- use: foundry patterns, core boxes, mold boards, prototypes, print models, negatives

- **Polyurethane resin SG 2000**

From selected two-component casting materials it was farther used Polyurethane resin SG2000

Table 4.
Physical properties of polyurethane resin SG 140/PUR 12

	SG 2000 Komp. A	SG 2000 Komp. B	Mixture SG 2000/Komp. A+B
Composition	resin	hardener	
Color	white	pollack	ivory
Mixing ratio [g]	100	100	
Viscosity at 25 ° C [MPa.s]	80±10	25±5	50±5
Density at 20°C [g/cm^3]	1,02±0,02	1,14±0,02	1,10±0,02
Processing time at 20°C na 200 g [min]			4
Curing at room temperature [min]			30-60

- high-quality, very fast curing liquid casting material
- use: foundry patterns, core boxes, mold boards, prototypes, print models, negatives
- material properties: FILLED casting material, the possibility of high performance, quality of curing, high strength and heat resistance.

5. Examination and assessment of the properties of castings

For experimental verification of changes in the properties of plastics with the addition of fillers know of the tensile test plastic (fig. 2), which is one of the most important mechanical tests. It is a method of ascertaining the behavior of plastics in uniaxial stress, to determine the basic strength characteristics of the material:
- Yield strength, Rm
- tensile strength, Re
- elongation A_5

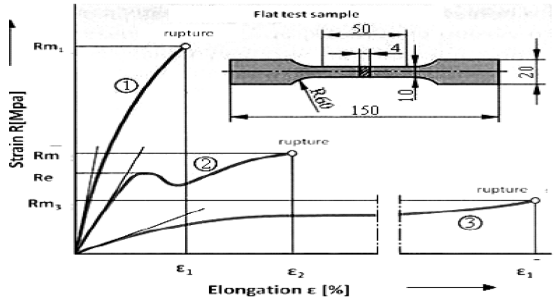

Fig. 2. Diagrams tensile test different types of plastics

According to the mechanical properties distinguishes three types of plastics:

- 1. hard, rigid plastic, for example. polystyrene (PS), unplasticized polyvinyl chloride (PVC), or polymethylmethacrylate (PMMA). Their most important parameter is the tensile strength Rm.

- 2. tough flexible (elastic) plastic with a distinctive yield strength Re in tension diagram, for example. highly homogeneous polyethylene (PE) or polyamide (PA).
- 3. elastic (flexible) plastic with high ductility ε example. butadiene rubber (BR) or a low homogeneous polyethylene (PE).

In the experiment used polyurethane resins among reactoplastics. In terms of their behavior under stress to move them can be classified into groups 2.

Table 5.
Test specimens for the evaluation of mechanical properties

Material	Nr. of rotations [speed/ min]	The thickness of the sample [mm]	Number of cast pieces	Number of cast samples from each% added filler
F 16	850	1;1,5;2;3	3	36
	850	1;1,5;2;3	3	36
SG140/ PUR 12	850	1;1,5;2;3	3	36
	850	1;1,5;2;3	3	36
	850	1;1,5;2;3	3	36
SG 2000	850	1;1,5;2;3	3	36
	850	1;1,5;2;3	3	36
	700	1;1,5;2;3	3	36
	Total			288

Table 6.
Overall assessment of the highest and lowest average values of tensile strength obtained in the experiment

Material	F 16	SG 140/ PUR 12	SG 2000
The highest yield strength has been achieved [MPa] (thickness of the sample [mm])	24,574/3	20,686/2	30,74/1,5
The lowest yield strength has been achieved [MPa] (thickness of the sample [mm])	17,463/1,5	13,211/1,5	20,194/1

6. Conclusions

In the evaluation experiment, which were used in all three polyurethane resins, it can be concluded that in terms of strength best results were achieved when a third polyurethane resin SG 2000. Experiment showed that the method for the production of smaller Tekcast parts and casting polyurethane resin may, in some cases, with casting zinc alloys, in particular for thin-walled shapes.

Centrifugal casting is a flexible technology for the production of prototypes and series uvádzacích in all industries. Cast a nature and accuracy closest to the technology of casting under low pressure. Applying all the advantages of centrifugal casting, this method fully meets the requirements of manufacturing functional parts and decorative objects, production of plaques, medals, pendants, giveaways and parts for leather goods.

In laboratories, Faculty of Special Technology in súčasnom time we developed the technology and verify procedures for centrifugal casting of polymeric materials to a level that we can this method creates a cast in which we managed by the application of prediction bugs to reach the standard quality.

Tekcast method for the production of smaller components except as resins. zinc alloy or eutectic of Silumin can compete with those alloys processing products produced by machining on CNC machine tools [9]. This publication was created with the support KEGA project (004-TnUAD-4/2012)

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