РУХАНИ ЖАҢҒЫРУ

20 АСТАНА

ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

Студенттер мен жас ғалымдардың
«ҒЫЛЫМ ЖӘНЕ БІЛІМ - 2018»
XIII Халықаралық ғылыми конференциясы

СБОРНИК МАТЕРИАЛОВ

XIII Международная научная конференция
студентов и молодых ученых
«НАУКА И ОБРАЗОВАНИЕ - 2018»

The XIII International Scientific Conference
for Students and Young Scientists
«SCIENCE AND EDUCATION - 2018»

12th April 2018, Astana

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ
Л.Н. ГУМИЛЕВ АТЫНДАҒЫ ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

Студенттер мен жас ғалымдардың «Ғылым және білім - 2018» атты XIII Халықаралық ғылыми конференциясының БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ XIII Международной научной конференции студентов и молодых ученых «Наука и образование - 2018»

PROCEEDINGS of the XIII International Scientific Conference for students and young scholars «Science and education - 2018»

2018 жыл 12 сәуір

Астана

УДК 378

ББК 74.58
Ғ 96

Ғ 96

«Ғылым және білім – 2018» атты студенттер мен жас ғалымдардың XIII Халықаралық ғылыми конференциясы = XIII Международная научная конференция студентов и молодых ученых «Наука и образование - 2018» = The XIII International Scientific Conference for students and young scholars «Science and education - 2018». – Астана: http://www.enu.kz/ru/nauka/nauka-i-obrazovanie/, 2018. – 7513 стр. (қазақша, орысша, ағылшынша).

ISBN 978-9965-31-997-6

Жинаққа студенттердің, магистранттардың, докторанттардың және жас ғалымдардың жаратылыстану-техникалық және гуманитарлық ғылымдардың өзекті мәселелері бойынша баяндамалары енгізілген.

The proceedings are the papers of students, undergraduates, doctoral students and young researchers on topical issues of natural and technical sciences and humanities.

В сборник вошли доклады студентов, магистрантов, докторантов и молодых ученых по актуальным вопросам естественно-технических и гуманитарных наук.

УДК 378

ББК 74.58

ISBN 978-9965-31-997-6

UDK 73.31.01

BRIEF CLASSIFICATION OF ADDITIVE TECHNOLOGIES

Otargaziyev Al-Farabi Nurtazovich
farik797@gmail.com
Eurasian National University,Astana, Kazakhstan
Scientific adviser – G.K.Taimanova

Introduction

Additive manufacturing (AM), also referred to as 3D printing, involves manufacturing a part by depositing material layer by-layer. This differs from conventional processes such as subtractive processes (i.e., milling or drilling), formative processes (i.e., casting or forging), and joining processes (i.e.,weldingor fastening). AM-technology allows you to design objects of complex spatial shape and design, without limiting the freedom of imagination and imagination; use the principles of bionic design, based on natural analogs (hollow, honeycomb, openwork and lattice structures resembling skeletons human, birds and animals, the structure of plants, etc.); to make in one operation the machine nodes as a single piece; automate the technological process parts, excluding the influence operator on the accuracy and quality of processing; reduce the number of technological operations and the laboriousness of manufacturing the product as a whole; delete a long period design and manufacture of expensive tooling; significantly reduce the cost and timing production of the first prototypes structures at the stages of R&D (Research andDevelopment).

Classification of additive technologies

Dynamically developing rapidly additive technologies of 3d printing are used in progressive industries. There are several innovative types of additive technologies. Below is a diagram (see Figure 1) reflecting the classification of additive technologies:

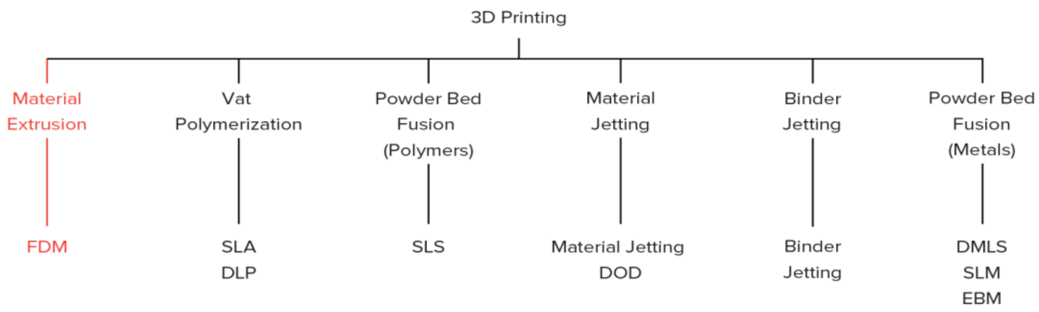

Figure 1 - Classification of additive technologies

Material extrusion

Fused Deposition Modeling (FDM), or Fused Filament Fabrication (FFF), is an additive manufacturing process that belongs to the material extrusion family.

Fused deposition modeling - the technology of additive production, widely used in the creation of three-dimensional models, with prototyping and in industrial production. FDM technology means the creation of three-dimensional objects by applying consecutive layers of material that repeat the outlines of the digital model. Typically, as materials for printing are thermoplastics, supplied in the form of coils of yarns or rods. The product, or "model," is produced by extrusion and application of microdroplets of molten thermoplastic with the formation of successive layers that solidify immediately after extrusion. The plastic thread is unwound from the coil and fed to the extruder - a device equipped with a mechanical drive for filament feeding, a heating element for melting the material and a nozzle through which the extrusion is carried out directly. The heating element serves to heat the nozzle, which in turn melts the plastic thread and delivers the molten material to the model being built. As a rule, the upper part of the nozzle is cooled by a fan to create a sharp temperature gradient, which is necessary to ensure a smooth feed of the material. Below is an illustration of schematic of a FDM printer (see Figure 2).FDM technology is highly flexible, but has certain limitations[1]. Although the creation of overhanging structures is possible at small angles of inclination, in the case of large angles, it is necessary to use artificial supports, usually created during printing and separated from the model after completion of the process. All kinds of thermoplastics and composites are available as consumables, including ABS (Acrylonitrile butadiene styrene), PLA(Polylactide).

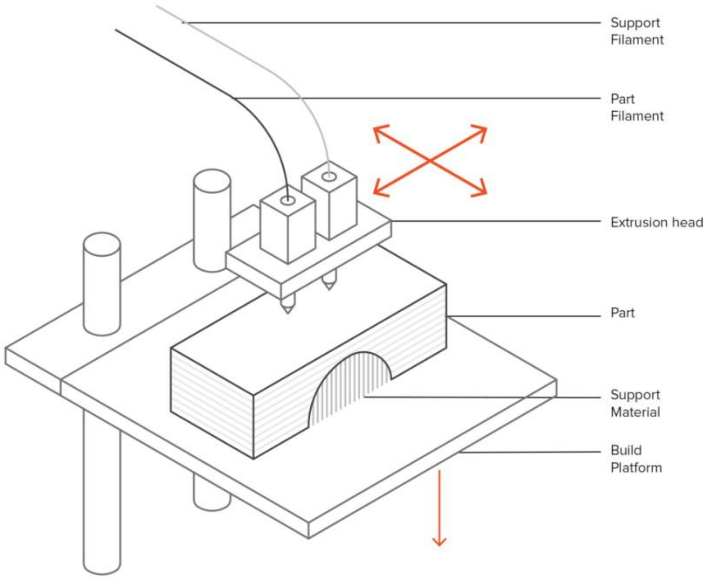

Figure 2 - Schematic of FDM 3D printer

FDM is one of the least expensive printing methods that provides the growing popularity of home printers based on this technology. In everyday life, 3D printers working on FDM technology can be used to create a variety of special purpose objects, toys, jewelry and souvenirs.

Vat Photopolymerization

Stereolithography (SLA) is an additive manufacturing process that belongs to the Vat Photopolymerization family. SLA - technology of additive production of models, prototypes and finished products from liquid photopolymer resins. Curing of the resin occurs due to irradiation with an ultraviolet laser or other similar energy source. The method is based on the irradiation of a liquid photopolymer resin with a laser to create solid physical models. The model is constructed layer by layer. Each layer is plotted by a laser according to the data stored in a three- dimensional digital model. Laser irradiation leads to polymerization (I.e. solidification) of the material at points of contact with the beam. When the contour is completed, the working platform is immersed in a tank of liquid resin at a distance equal to the thickness of one layer - usually from 0.05 mm to 0.15 mm.

After the leveling of the surface of the liquid material, the process of constructing the next layer begins[2]. The cycle is repeated until the complete model is built.

After completion of the construction, the products are washed to remove the residual material and, if necessary, are subjected to treatment in an ultraviolet oven until the photopolymer is completely solidified. Below is an illustration of schematic of a SLA printer (see Figure 3).

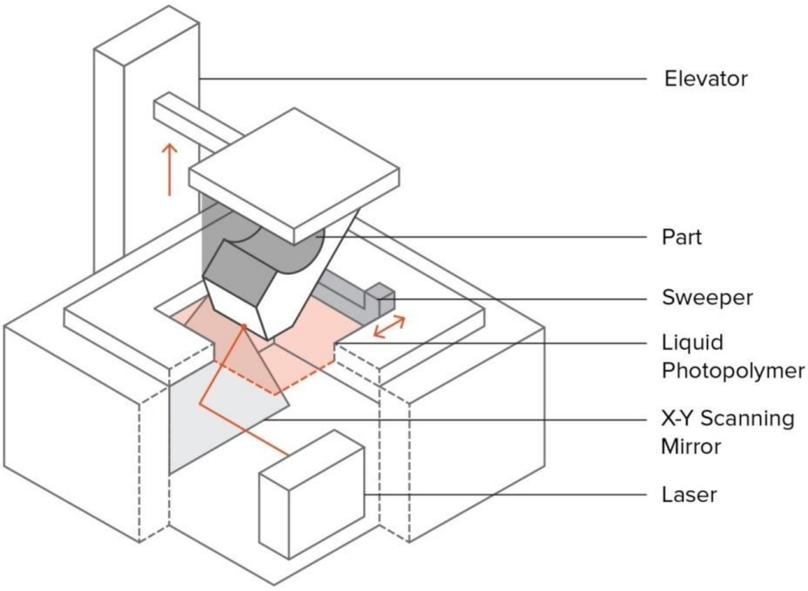

Figure 3 - Schematic of a SLA 3D printer

The main advantage of stereolithography can be considered high accuracy of printing. The existing technology allows the application of layers 15 microns thick, which is several times smaller than the thickness of a human hair. Precision of manufacturing is high enough for application in the manufacture of prototypes of dental prostheses and jewelry. The speed of printing is relatively high, given the high resolution of such devices: the time of building one model can be only a few hours, but ultimately depends on the size of the model and the number of laser heads used by the device at the same time. Relatively small desktop devices can have a build area from 50 to 150 mm in one dimension. At the same time, there are industrial plants capable of printing large-scale models, where products are measured in meters. Finished products can have different mechanical properties depending on the inherent characteristics of the photopolymer: there are simulators of solid thermoplastic, rubber and other materials.

Powder Bed Fusion

Selective Laser Sintering (SLS) is an additive manufacturing process that belongs to the Powder Bed Fusion family. The technology is based on successive sintering of layers of powder material using high power lasers. SLS is often mistaken for a similar process, called selective laser melting (SLM). The difference is that the SLS provides only partial melting necessary for the sintering of the material, while selective laser melting implies the full melting required to build monolithic models. Technology (SLS) involves the use of one or more lasers (typically carbon dioxide) to sinter the particles of powder material to form a three- dimensional physical object. Plastics, metals (Direct Laser Sintering of Metals (DMLS)), ceramics or glass are used as consumables. Sintering is performed by drawing out the contours embedded in the digital model (the so-called "scan") with the help of one or several lasers. After the scan is completed, the working platform is lowered and a new material layer is applied. The process is repeated until a complete model is formed. Since the density of the product does not depend on the duration of irradiation, but on the maximum energy of the laser, pulsating radiators are mainly used. Before printing, the consumable is heated to a temperature just below the melting point to facilitate the sintering process. Unlike such additive production methods as Stereolithography (SLA) or layered fusion modeling (FDM), SLS does not require the construction of support structures. The hinged parts of the model are supported by unused material. This approach allows to achieve almost unlimited geometric complexity of the models manufactured.

Below is an illustration of schematic of a SLS printer[3] (see Figure 4).

SLS technology has become widespread worldwide due to the ability to produce functional details of complex geometric shapes. Although the technology was initially created for rapid prototyping, SLS has recently been used for small- scale production of finished products. It was quite unexpected, but interesting application of SLS was the use of technology in the creation of art objects.

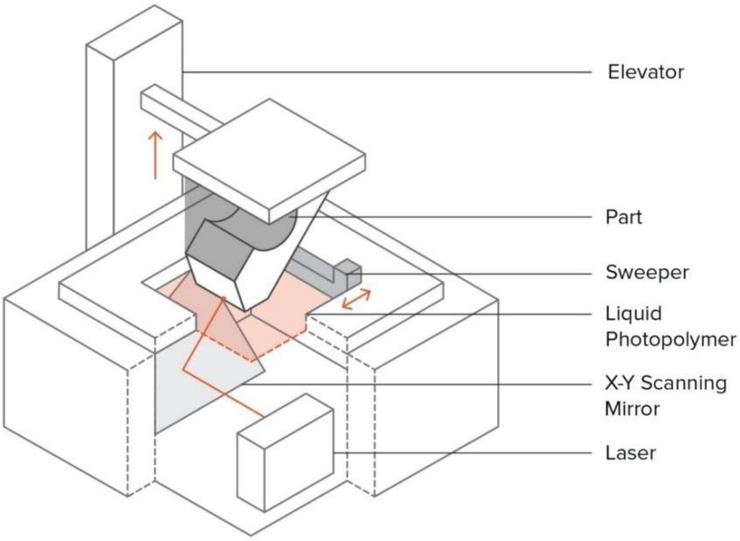

Figure 4 - Schematic of a SLS 3D printer

Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS) are two metal additive manufacturing processes that belong to the powder bed fusion 3D printing family. The two technologies have a lot of similarities: both use a laser to scan and selectively fuse (or melt) the metal powder particles, bonding them together and building a part layer-by-layer. Also, the materials used in both processes are metals that come in a granular form. The differences between SLM and DMLS come down to the fundamentals of the particle bonding process (and also patents): SLM uses metal powders with a single melting temperature and fully melts the particles, while in DMLS the powder is composed of materials with variable melting points that fuse on a molecular level at elevated temperatures. Essentially: SLM produces parts from a single metal, while DMLS produces parts from metal alloys. DMLS technology is used for the manufacture of finished products of small and medium size in various industries, including aerospace, dental, medical, etc. The typical size of the area of construction of existing plants is 250x250x250 mm, although there are no technological limitations on the size - it is only a question of the cost of the device. DMLS is used for rapid prototyping, reducing the development time of new products, as well as in production, allowing to reduce the cost of small lots and simplify the assembly of products of complex geometric shapes. Below is an illustration of schematic of a SLS/DMLS printer(see Figure 5). The technology of selective laser melting is used to construct objects of complex geometric shape, often with thin walls and cavities. The possibility of combining homogeneous and porous structures in one object is useful in the creation of implants - for example, acetabular cups or other orthopedic implants with a porous surface, promoting osseointegration (splicing with bone tissue). In addition, SLM is successfully used in the aerospace industry, allowing the creation of high-strength structural elements that are unattainable in geometric complexity for traditional mechanical methods of manufacturing and processing (milling, cutting, etc.). The quality of finished products is so high that mechanical processing of finished models is almost unnecessary. A side-effect is the saving of materials, because SLM is, by virtue of its specifics, practically non- waste product.

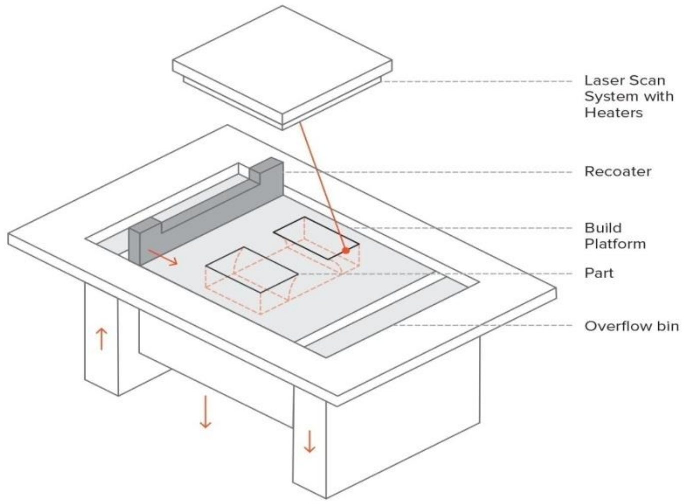

Figure 5 - Schematic of a SLM/DMLS 3D printer Material Jetting

The technology of multi-jet modeling combines features of 3D printing methods such as 3D inkjet printing, layered fusion modeling (FDM / FFF) and stereolithography (SLA). The layers are built using a special print head equipped with an array of nozzles. The number of nozzles in existing printer models ranges from 96 to 448. Printing is made by thermoplastics, waxes and photopolymer resins. In the first two cases, the materials harden by gradual cooling. In the case of printing with photopolymers, each applied layer is treated with an ultraviolet emitter for polymerization (solidification). MJM (Multi-jet modeling) allows youto create supports for overhangs of models from relatively low-melting wax. If auxiliary wax structures are used, after the printing is finished, the finished model is placed in the oven (built-in or separate) and heated to a temperature of the order of 60 ° C for wax melting. The technology allows to achieve exceptionally high levels of accuracy comparable to laser stereolithography (SLA) - the minimum thickness of the applied layer can be 16 microns, and the resolution of printing in the horizontal plane reaches 750x750x1600 DPI. Below is an illustration of schematic of a SLS/DMLS printer (see Figure 6).

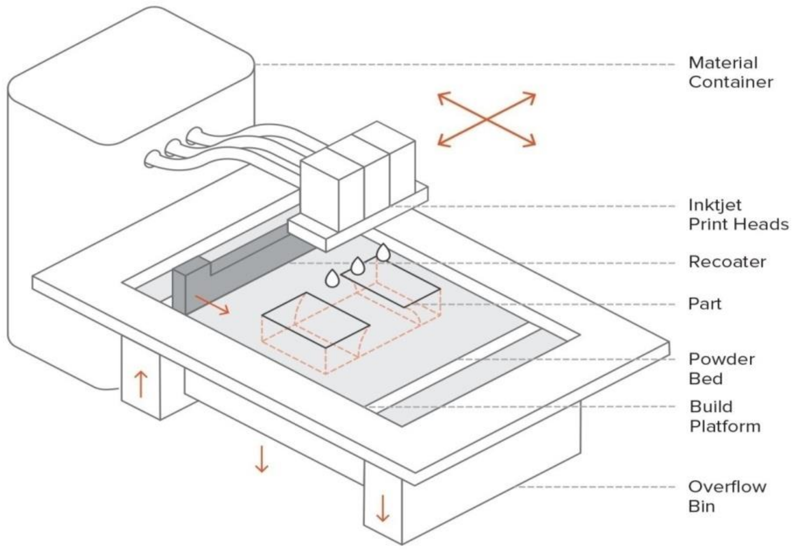

Figure 6 - Schematic of a MJM 3D printer

MJM technology is used in various industries, requiring the creation of high- precision prototypes and finished products. Among the areas of application can be called dentistry, jewelry, industrial and architectural design, the development of electronic components, etc.

Binder Jetting

Binder Jetting technology - layer-by-layer bonding of composite powder with a binder (usually - based on gypsum or quartz sand). The working chamber of the 3D printer working on Binder Jetting technology consists of two parts: the powder feeding chamber, into which the consumable is loaded, and the construction chamber where direct printing is carried out. The product is printed layer by layer, where the material is distributed evenly throughout the entire plane of the construction chamber platform, and then, according to the calculated mathematical model, a binder is applied to this layer, gluing the particles of the material together, forming a cross-section of the future product[5]. After applyingglue, the platforms of both cameras are displaced: one down, one up (in some printers only the construction platform is displaced, the layer thickness is down). After the displacement, the next layer of powder is applied to the platform in the construction chamber, and the print head starts its movement again, applying a binder. The process is repeated until the last layer is applied. During 3D printing, unbound powder surrounds and supports the part in the working chamber, and after the end of printing can be used again. Below is an illustration of schematic of a Binder Jetting printer (see Figure 7).

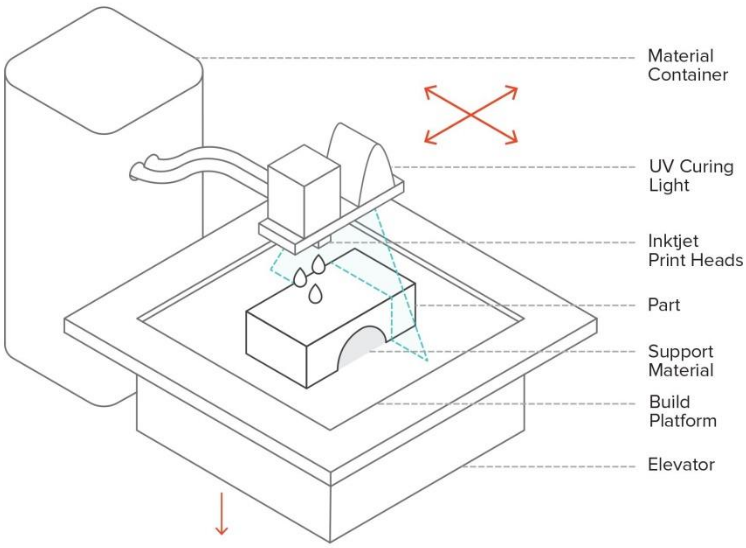

Figure 7 - Schematic of a BJ printer

Today, this is the cheapest option to make a product on a 3D printer, which is one of the industrial ones. In addition, it is the only commercially successful technology today that allows you to produce a fully colored product in the CMYK color scheme.

Conclusions

The choice of AM-technologies is carried out, based on the assessment of the following criteria:

- cost ofacquisition;
- productivity;
- quality of the modelsurface;
- the degree of detail (the ability to build smallfragments);
- accuracy of construction;
- labor intensity ofpost-processing;
- stability of the modelmaterial;
- the life of the machine (printer) before replacing themain components;
- cost of model (building and auxiliary)materials;

- reliability and delivery time of consumables and spareparts;
- development of the technical support service in theregion;
- the cost of routine maintenance of themachine;
- the cost of the service contract (in the post-guaranteeperiod);
- reliability and durability of themachine;
- the life of the main nodes before replacement oroverhaul;
- the required qualifications and, accordingly, the cost of the servicing staff, as well as the required installation area and engineering infrastructure.

Depending on the specific situation, each of these criteria has a different significance.

References

1. Ian Gibson, David Rosen, Brent Stucker. Additive manufacturing technologies. 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing. Second edition. // Springer-Verlag New York, 2015. p.147- 171. DOI: 10.1007/978-1-4939-2113-3-book
2. Jorge V. L. Silva, Rodrigo A. Rezende. Additive Manufacturing andits future impact in logistics. // 6th IFAC Conference on Management and Control of Production and Logistics, 2013 - sciencepaper
3. Frazier, W.E. Metal Additive Manufacturing: A Review// Journalof Materials Engineering and Performance, 2014, volume 23: p.1917- 1928.DOI: 10.1007/s11665-014-0958-z -sciencepaper
4. Hongyi Yang, Jingying Charlotte Lim, Yuchan Liu, Xiaoying Qi, Yee Ling Yap, Vishwesh Dikshit, Wai Yee Yeong & Jun Wei. Performance evaluation of ProJet multi-material jetting 3D printer// Virtual and Physical Prototyping, Volume 12, 2017 - Issue 1.DOI: 10.1080/17452759.2016.1242915 - science paper
5. Brett P. Conner ∗, Guha P. Manogharan, Ashley N. Martof, LaurenM.Rodomsky, Caitlyn M. Rodomsky, Dakesha C. Jordan, James W. Limperos. Making sense of 3-D printing: Creating a map of additive manufacturing products and services // Additive Manufacturing,Volumes 1–4, October 2014, Pages 64-76. DOI: 10.1016/j.addma.2014.08.005 -science paper

UDC 621.37

RESEARCHES AND OPTIMIZATION OF TECHNOLOGICAL OPERATIONS OF MAINTENANCE AND REPAIR OF CARS

Saparov Rustem

sapargk@mail.ru

Master of Science in Transport and transport technologies, KSTU, Karaganda, Kazakhstan

Scientific adviser –S.Kabikenov

Modern economic conditions objectively change the relationship between consumers and service providers. Motor transport enterprises, in the face of intense competition and escalation of the need for systematic improvement of technological processes, inevitably strive to maximize the rationalization and increase the productivity of the service of vehicle maintenance and repair.

The growth in the number of cars and the increase in the requirements for traffic safety and environmental safety give rise to the need to improve the management system of the technical condition of the vehicle fleet.

From the rationality and scientific organization of maintenance and repair depends on operational reliability, safety and environmental friendliness, operational costs, controllability of the department for maintenance and repair, the level of quality of the services provided.

Modern conditions of operation of cars make high demands on its technical and operational properties. The requirements for increasing the economy and improving the environmental friendliness of the use of fuels and lubricants are now coming out on top. Optimization of measures