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EXPEDIENCY OF THE USE OF TECHNOLOGY DETONATION SPAYING FOR FORMING COVERAGES FROM POLYMERIC MATERIALS

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Abstract. On the basis of analysis of technological possibilities and features of technology of detonation coverage and undertaken studies expediency of the use of this technology is educed at overcoating from polymeric thermoplastic powder-like materials. Tasks are put on structurally-technological realization of equipment of detonation coverage, research and experimental directions of decision of materials tasks of gelation of coverages at detonation coverage of polymeric materials. The influence of the temperature of the particles of the powder material to form polymeric coatings during coating process to their performance properties such as the amount of elastic deformation and durability.
Keywords: Detonation spraying, functionally-oriented coverages, polymeric materials, powder-like feeders.

1. Introduction

The necessity of providing of competitiveness of the products manufactured by producers increases in realities of globalization of world economy, that directly in area of engineer actualizing a different job mix, including task of decline of cost of the construction materials used for making of machines and mechanisms. By the rational way of decision of task of providing of quality of physical and mechanical properties of details, including the condition of replacement of expensive construction material, there is the use of coverages. For expansion of perspective spectrum of physical and chemical properties of coverages are of interest coverage from polymeric materials, in the use of that last a decade takes place steady tendency of increase of volume and purviews in all industries of industry, medicines and other industries. Deployment of polymeric coverages is related to their by high mechanical, chemical, dielectric and by other properties of polymeric materials.

To the most known methods that can be used for forming of polymeric coverages, belong:

– casting under constraint: a detail is placed in the press-form set on the table of castable machine, and inject through a nozzle fusion of material, that, spreading in the internal cavity of press-form, forms coverage on the surface of detail [1];

– pressing under constraint: polymeric press-material as powder is loaded in a press-form and expose to the action of heat and pressure, here -it grows soft and spreads in the internal cavity of press-form, accepting configuration of surface of detail [2];

– it is vibrovortical coverage of powder: hot metal heated on the temperature to 30÷50°With higher than temperature of melting of polymer place in the pseudofluidized layer of powder-like material in the electrostatic field or without it, maintain in it set time. The particles of powder, intensively mixed under act of passing air or rare gas, settle on the surface of the heated detail, melting, growing into even coverage without pores [2, 3];

– it is stream coverage: powder-like material by means of pneumatic pistol covereges on hot metal in the electrostatic field or without it [1];

– it is an extrusion: powder-like material at the continuous loading, melting with his simultaneous interfusion and squeezing out through corresponding attachment, for example cannon-

bit or circular head, inflicted on the covered

surface to the constantly moved detail [2, 4];

– it is the flame spraying of powder (GPNP): powder-like material is transported the stream of air in the zone of expiration from the gasring of foods of combustion of working gases, where heated to passing to the plastic or viscidly-fluid state, acquiring ability to stick to the surface of the covered detail, that must be heated to the certain for every polymeric compo temperature, so-called temperature of spreading [3, 5].

The basic and general technological parameters of forming of polymeric coverages in the indicated methods is providing of the corresponding temperature and pin affecting powder-like polymeric material. Not dependency upon composition of coverage in all methods of forming of polymeric coverages quality of coupling of coverage with the processed surface of detail is provided by general and special technological receptions. For example, general technological receptions it is been mechanical and thermal treatment [1, 3, 6], and also adjusting of parameters of temperature of material of coverage and size of pressure in the zone of forming of coverage in the set temporal cycles of forming [1-3, 5, 7]. To the special technological receptions, improving quality coverages, belong: re-enforcement [8], causing on it intermediate layer (sublayer) [6], and also forming of functionally-gradient or functionally-oriented coverages [9-11]. Indicated and other corresponding technological receptions of forming of coverages can be used it is combined.

On the whole foregoing technologies of causing of polymeric coverages have different functional limitations, depending on the sizes of details, placing of zones of overcoating and their physical and chemical parameters, in this connection, the necessity of expansion of spectrum of the used methods takes place for overcoating from polymeric materials. For overcoating from the polymeric materials included in the group of thermoplasts (polypropylene, fluoroplastic et al), by such method there can be detonation coverage of powder (DNP). A process of DNP is a cyclic and a fed-batch of particles of sputtered material and working gases in the barrel of setting of detonation coverage (UDN), and also subsequent warming the impulsive acceleration of these particles as a result of the detonation mode of combustion of working gases [5, 12, 13].

The options of detonation coverage are widely presented for overcoating on the basis of metallic and ceramic powder-like materials, having analogical and general for coverage of such materials structurally-technological decisions and receptions [5, 12-18] and locally enough used for causing of polymeric coverages.

2. Method

Features and possibilities of DNP process allow to combine and extend the row of the technological receptions used for polymeric coverages forming. It maybe to provide due to the recurrence of process, giving an management opportunity the local modes of his single cycle in composition all cycle of overcoating. For example, combination of all above-named technological receptions of forming of coverages is possible from polymeric materials, namely: mechanical and thermal treatment , adjusting of parameters of temperature of material of coverage and pressure in the zone of forming of coverage on different temporal cycles, re-enforcement and causing on it sublayer, and also functionally-gradient or functionally-oriented change of composition of material of coverage.

In addition, due to varying management parameters such technological receptions can the individual modes of separate knots of UDN comport in the set temporal intervals of general cycle of process of causing of polymeric coverages real time, that it is practically impossible to realize in the technological methods based on continuous processes.

General appearance of DNP chambered hardware, which is engineered on “Mechanical engineering technology” chair of Donetsk National Technical University, is shown on the fig. 1. DNP technology is used for recovery of worn-out components surfaces as well as for new wares production, including replacement of expensive constructional materials of components base to more low-cost due to coatings laying. For example, brass components could be produced of steel with the

Fig. 1. Chambered hardware of DNP

following brass laying.

Technological possibilities of DNP allow sputtering of metal, ceramic and polymeric powder materials and their compositional structures with coatings depth from 100 μm till several centimeters in order to get hardwearing, frictional, heat-conducting, chemical-stable, thermo-stable and other specific purpose coatings.

During functional-oriented detonation coatings laying the laying methods of multilayer and functional-gradient detonation coatings could be used as basic constituents of technological process. The main difference of functional-oriented coatings is laying of dimensionally coherent local sections of solid or chemically different powder materials which differing with their physic-mechanical properties on surface of sputtered component. Increase of operational component properties could be optimized and provided by the detonation laying of local sections of chemically different powder materials on component surface (Fig. 2). Also there is possible to plot dimensionally coherent local sections differing by fractional particles size to form of covering local sections with different coefficients of porosity [11].

Fig. 2. External appearance with functional-oriented coatings

The technological features of overcoating from polymeric materials are predefined the method of DNP by the substantial difference of phyisico-mechanical parameters of polymeric materials from metallic and ceramic powder-like materials, in this connection require corresponding individual technological decisions. Such differences of eliminating, for example, use of technological reception of causing of polymeric coverage by means of method of reflection of coverage powder-like material. At forming of polymeric coverages the method of DNP the use is also impossible of technological reception of layer treatment of the formed coverage the particles practiced at overcoating from metallic and ceramic powder-like materials.

In addition, difference of physico-mechanical parameters of polymeric materials from the analogical parameters of metallic and ceramic powder-like materials, and also gas-dynamic features of behavior of such particles of powder-like materials are principal reasons of necessity of the use of corresponding structural decisions of separate knots of UDN consumers, for example, powder-like consumer and barrel.

To the design-engineering constituents of parameters of realization of UDN for causing of polymeric coverages belong decision of row of tasks of optimization of her separate knots and receptions of management by the making components of process, influencing on the efficiency uses of potential of method of detonation coverages, other constituents belong also, for example:

– it is providing of the assured defence of powder-like consumer from influence of backstroke of foods of detonation, that it is necessary for providing of his capacity;

– it is realization of methods of serve of working gases and powder-like material in the barrel of UDN for providing of optimization of position of powder-like material in the single loop of process of overcoating;

– it is the use of different screens, cowlings and reflectors for forming of stream of foods of detonation, outflowing from the barrel of UDN with the particles of powder-like material, that promotes efficiency of process of forming of coverage;

– it is realization of receptions of initiation of burning of working mixture of gases, that influences on parameters of the detonation modes of combustion of working mixture of gases, and also on quality of forming of diphasic stream of foods of detonation of these gases and powder-like material;

– it is co-ordination of change of distance of coverage in the process of overcoating, that provides management possibility the process of forming of structure overcoated and, accordingly, his descriptions.

To the primary research concerns of development and planning of technology from polymeric powder-like materials it is possible to take:

– creation of theories of behavior of stream of foods of detonation (PPD) with the particles of polymeric powder and forming of single layer of coverage on a coverageble surface, being by the base constituents of process of theoretical prognostication set quality structure and physico-mechanical properties of coverage;

– optimization of physico-technology properties of the coverages of polymeric powder-like materials used for causing for providing of optimal parameters of formation of gas-powder mixture in the barrel of UDN and process of their co-operation with PPD on to the structure of forming of polymeric coverage;

– researches and analysis of features of forming of monodispersible with polimeric powder-like materials having different physico-technology properties, processes of expiration of such polimerical particles in PPD, including at uses of different screens, cowlings of both reflectors and processes individual character of forming of polymeric coverages;

– researches of features of the dynamic affecting forming of polymeric coverage, for example, oscillation;

– study of technological receptions of causing of different on the physico-mechanical properties polymeric powder-like materials;

– study of physical and chemical processes of forming of polymeric coverage on his different stages: substrate is a primary superficial layer of coverage, primary superficial layer of coverages is a subsequent layer of coverage (processes and pattern of behaviour of particles at a dynamic contact, and also subsequent processes of deformation, spreading and cooling of coverage particles of powder);

– study of physical and chemical properties of polymeric and composition (formed with the use of metallic and ceramic powder-like materials) coverages in dependence from the features of forming of coverages a for example, functionally-gradient or functionally-oriented;

– design of physical and chemical and mechanical properties of polymeric and composition coverages.

3. Conclusion

Application of different kinds got detonation coverage of polymeric coverages from amorphous and crystalline thermoplastic powder-like materials, at attained technological level, mainly behaves to wearproof coverages. The prospect of expansion of areas of the use of polymeric coverages takes place, for example, chemical proof and elecrical-protective. At causing of the functionally-oriented coverages technology of detonation coverage can be used as for causing of metallic and ceramic areas of coverage, so for causing of polymeric areas of coverage on the surfaces of details.

The influence of the temperature of the particles of the powder material to form polymeric coatings during coating process to their performance properties such as the amount of elastic deformation and durability.

Design-engineering realization of equipment of detonation coverage of polymeric powder-like materials must be base on results of design and experimental researches of processes of causing and forming of polymeric coverages in the wide spectrum of study of pattern of behaviour of amorphous and crystalline thermo-plastic powder-like materials in the process of forming of polymeric coverages.

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