NEW ECOLOGICAL BINDER MATERIALS BASED ON VEGETATIVE RAW MATERIALS PROCESSINTG PRODUCTS

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Summary. Rise in price of binders production is based on oil and its derivatives has led to the economic inexpediency of using many traditionally used binder materials. Considerable toughening of ecological requirements to production revealed principal impossibility to use many traditional materials because the products generated using them are toxic. It involves deterioration of labor conditions and destabilization of environment ecological indices. These stipulate the search of acceptable alternatives. One of which may be enlargement of vegetative raw material processing products as binder materials.

Key words: vegetative raw materials, binder materials, technical lignosulfonats, binder ability.

STATE OF PROBLEM

Modern production is impossible without use of different bonding materials, which are called differently in different technological processes (binders, cementing materials, glues, strengthening, etc.), but they perform one and the same function. That is, they produce a unity out of homogeneous or heterogeneous parts which is characterized by strength index. The major part of the industry producing and applying binder materials uses the products of processing of carbohydrate raw materials (oil, gas, coal) deposits of which are limited and extracting of which is sometimes expansive and unsafe, as source materials. That is why the price for these materials has been increasing nowadays. The application of binders of such genesis is ecologically harmful at all stages of their processing cycle and application because they release toxins under the influence of different factors and in the result of vaporization process and destruction. At present, the major vector of scientific developments in the sphere is devoted to perfection of technological processes using the abovementioned types of binders compositions [Boldin 2006]. It is realized due to some physiochemical influence such as introduction of certain active components (plasticizers, activators, catalyzers, hardening agents, etc.) to perfect production technically but oes not solve the problem.

Alternative solutions may be found by wider use of products, to be more exact, wastes of vegetative raw materials processing. As a rule, such technologies are aimed at recovering, extraction of plant's "useful" mass, which reduces destruction of natural

polymer matrix and separation of 'product' from 'ballast'. 'Ballast' accounts for 30-40% of source material. Technologies of cellulose and sugar production may be vivid examples. These productions are characterized by 85-90% of generating large-capacity wastes (counted by 'solid residue') consisting of the natural polymer thermo-chemical destructions products – lignine, which is a binder element in a plant. That is why it is advisable to use these wastes according to their natural function - as a raw material for development of new binder materials. In case of cellulose production these are technical lignosulfonats (LST), and of sugar production it is syrup. Positive distinguishing feature of this class binders is that they are ligno-containing materials, and like wood, do not produce any irritation, phobia, or allergic reactions, while they are much cheaper than the binders based on carbohydrate raw materials (oil, gas, coal). Both products, which are actually waste, possess different binding ability. The second one (syrup) is in greater demand but in a form of forage addition in cattle farming and the first one (LST) is used as a binder but only in quantity of 5-7% of produced volumes, though their production constitute three million tons a year in CIS countries. Given number is comparable with total consumption volume of binder materials in these countries. A disbalance in their use is explained by a low binding ability and instability of LST properties [Semik 1996.].

PURPOSE OF THE WORK

Aim of investigations under development has been firstly, bringing binding abilities of lignine-containing materials, particularly LST, to the level of highly-efficient binder materials such as synthetic resins, and oil-binder materials; secondly, stabilization of these materials (LST) properties, i.e. provision of long- perspective steady and stable quality indices; thirdly, the search of possibilities for adaptation potential of obtained in such a way binder composition according to a certain technological process requirements. Finally, it will allow to solve a set of production problems, namely, rise of material ecological safety level, hygiene and sanitary labor conditions improvement at the working places; production cost lowering while observing required quality level.

ESSENCE OF DEVELOPMENT

The essence of the given development is in the usage of a succession of different physico-mechanical, thermal, and chemical influences on compositions with LST to increase their binding abilities, in particular combination of modification methods and mechanical treatment. The sense of modification process is in that LST undergoes combined influence consisting in introduction of definite proportions of complex action chemical components allowing to initiate a processes of three-dimensional polymer screen formation which provides significant (ten times) increase of binding ability of obtained compositions. The sense of mechanical processing consists in mechanical influence on LST – processing with the help of highly-energetic disintegrator, leading to formation within the structure of a binder active centers, free radicals, which are a kind

of centers initiating processes of polymerization accompanied by three-dimensional screen structures, providing high integral strength of binder composition comparable with highly-efficient materials like synthetic resin. Temperature processing of proposed binder compositions based on LST aimed at composition homogenizing is performed at different stages of there application to provide stability of their characteristics or to intensify polymerization processes.

Combining enumerated methods of influence on LST as a typical product vegetative raw material processing it is possible to adopt obtained binder compositions to the requirements of different technological processes in the widest range of indices [Svinoroev 2005, 2009].

EFFECTIVENESS OF RESULTS

Suggested development allows to increase LST binding ability from 0.03-0.05MPa/% up to 0.5-0.7 MPa/% which is comparable with the most effective binder materials such as synthetic resin, for which this index equals 0.5-0.9MPa/%. At this, basic technological characteristics became stable which makes adaptation of each newly received by the work-shop lot of binder unnecessary (this was one of the major factors to abandon the LST use). In this case seasonal factors do not play a decisive role in influencing on the material quality indices any more.

The reduction of hardening cycle from 30 to 50% as well as the use of proposed compositions in processes where lignosulfonic binder has never been used before (core hardening in 'hot boxes', in technological processes of linear production) is possible.

Obtained compositions on the bases of lignosufonic binders, LST in particular, exceed ecological indices (reduction of harmful emissions) of all binder materials based on hydrocarbon raw materials. Lignine (natural biopolymer not emitting toxins) is the basic material for all compositions obtained in accordance with proposed development. At this, hygiene and sanitary conditions at working places are considerably improved. Statistics of such binder materials usage testify to the reduction of respiratory diseases by 23-37%. According to the data obtained by NIIOT (City of Ekaterinburg) LST materials ecological indices, in particular, are the best if compared with the other organic binder materials [Suvorov 1987].

A great number of unclaimed wastes which are used in LST production defines their availability and low cost. Renewable source materials (wood, plants) define lack of background for any change in this state in the foreseeable future. In price term it gives the following numbers: one ton of non-modified LST from 60 to 100 \$ USA, one ton of composition based on modified LST from 150 to 200\$ USA, at the same time price range of synthetic risen makes from 450 to 2500 \$ USA a ton depending on the grade.

Such effectiveness indices allows for gradual exclusion of expensive and ecologically dangerous binder materials (synthetic resin) from technological processes and their replacement by proposed materials based on vegetative raw materials processing products.

EXAMPLES OF IMPLEMENTATION

The development is implemented for the technology of cord production when manufacturing radiators and cast iron shaped castings; formanufacturing hubs of pressure and carriage pipes in foundry production.

The development may be implemented in different bulk materials pelletization processes in metallurgical and metal mining industry (e.g. in briquetting of central concentrating mills exhausted setting tanks coal screening, etc.) when producing particle and fiber boards, and plywood in woodworking industry as well as in production of composite materials.

The most productive and perspective trend is modification which is confirmed by the results obtained (see Table 1). The use of modified LST allows to decrease the use of oil binder KO which is a source of harmful emissions in structure of core sand mixture by 3.5-4.0 times.

Analysis of presented core sand mixtures used in technological processes of radiator productions shows that the use of modified LST allows to decrease the application of oil binder KO, which is 3-4 times more expensive than LST and is a source of harmful carcinogens (benzopiren) emission into environment by 4 times [Platonov 1989]. While using modified LSDs quality indices both of core sand mixture and a core and consequently of foundry goods, are at the given normative level.

N₂	Component composition and mixture	Mixture quantitative indices:	
	quality indices	Presently used	Proposed for
		-	introduction
1	Filling agent: quartz sand, grade 1K026, %	100	100
2	Binders:		
	LST ,%	4.0-4.5	-
	Modified LST,%	-	4.0-4.5
	КО (УСК)б%	3.5-4.0	0.8-1.0
3	Technological additions:		
	Ammonium sulfate,%	0.19	-
	Diesel-fuel,%	0.5	0.5
4	Strength after dehydration at breakdown test, MPa	1.8-2.5	1.8-2.5
5	Compression strength in raw state, kgc/cm	0.055-0.065	0.06-0.07
7	Humidity,%	3.3	2.7

 Table 1. Compositions and characteristics of core sand mixtures to be used in technology of radiators production

WORK RESULTS

The following conclusions may be done as a result of investigations carried out: Because the instability of characteristics and low binding ability, LST as a binder is used as much as 10% of its potential and at these are:

- 1) ecologically pure;
- 2) potentially cheap and not scare;
- 3) technological in processing of materials having a possibility to adopt to the requirements of different technological processes.

Taking into account obtained experience in LST application as a binder in foundry production and existing scientific potential LSTs may be considered as perspective raw material for development of new binders having stable and prespecified characteristics.

Obtained results prove the possibility to extend the sphere of lignine-containing materials, products of vegetative raw materials processing, application (shown on an example of LST), to solve the general-ecological problems of manufacturing by eliminating sources of harmful emissions generation from the technological processes. They illustrate the method of hygiene and sanitary conditions at working places improvement; realize aimed at finished products costs reduction while providing required quality parameters.

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НОВЫЕ ЭКОЛОГИЧЕСКИЕ СВЯЗУЮЩИЕ МАТЕРИАЛЫ НА ОСНОВЕ ПРОДУКТОВ ПЕРЕРАБОТКИ РАСТИТЕЛЬНОГО СЫРЬЯ

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Аннотация. Удорожание связующих, для которых первичным сырьем служит нефть и ее производные, привело к тому, что с экономической точки зрения стало не выгодно использовать многие традиционно применяющиеся до сих пор связующие материалы, а значительное ужесточение экологических требований к производству выявило принципиальную невозможность применения многих традиционных материалов по причине токсичности продуктов, образующихся при их использовании, что ведет к ухудшению условий труда на производстве и дестабилизации экологических показателей окружающей среды. Это обуславливает поиск приемлемых альтернатив, одной из которых может стать распирение применения в качестве связующих материалов продуктов переработки растительного сырья.

Ключевые слова: растительное сырье, связующие материалы, технические лигносульфаты, связующая способность.