

ferent design models and assumptions for the mobile units and the track has been evaluated.

Originality. We have determined the relations between the parameters of horizontal and vertical burrs in rails and the changes in burden, stability and movement safety of the mine cars at straight and curved sections of the rail track. We have discovered the resonance phenomenon caused by the proximity of the frequency of forced and natural vibrations of cars and determined critical speed for the safe mode of movement. We have determined the right scheme and allowance for moving units with loose and firm mounting of wheels on axles of wheelpairs.

Practical value. The obtained results of the research can be used to develop technical standards for construction, maintaining and repair of the rail track taking into account valuation of allowances for the rail track width, horizontal and vertical irregularities, and providing the required burden, stability, and movement safety parameters.

Keywords: *mine track, mine car, burden, stability, safety, mathematical modeling*

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АВАРІЙНА ОПОРА З ЕКОЛОГІЧНОГО ТЕРМОПЛАСТИЧНОГО ПОЛІМЕРНОГО КОМПОЗИТУ ДЛЯ БЕЗПЕЧНОЇ ЕКСПЛУАТАЦІЇ КОЛІСНОГО РУШІЯ ВАНТАЖНИХ ТРАНСПОРТНИХ ЗАСОБІВ

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THE EMERGENCY SUPPORT MADE OF THERMOPLASTIC POLYMER COMPOSITE FOR SAFE OPERATION OF PNEUMATIC-TIRED WHEEL OF CARGO VEHICLE

Purpose. To develop the means of creation of thermoplastic polymer composites with long-term constructional properties for safe operation of tire products.

Methodology. To achieve the goal we have used the empirical research methods (standard and model physical and mechanical test of the composites under long-term static and dynamic compression loads) in the laboratories of the Ukrainian State University of Chemical Technology and VAT “Dniproshina” (Ukraine) and have conducted the microscopic laboratory research in the National technical University of France (Sent-Etienne).

Results. We have considered the functional appropriateness to retrofit the traditional pneumatic-tired wheel with a special emergency support to ensure the safety of cargo vehicles in case of pneumatic tires damage. According to modern requirements of resource saving and environment protection in creating new products or additional items to already existing ones, the wheel running gear should retain acceptable level of its operational properties in the state of emergency rolling and reparability of damaged tires and have unlimited capacity for recycling. The research in the field of materials engineering allowed us to use the specially designed thermoplastic polymer composite for the emergency support development instead of traditional rubber, which is unacceptable for this purpose. A special list of constructional and technological properties allows us to avoid many problems of production, exploitation and processing, but require such constructional solutions of emergency support which let us to avoid using reinforcing elements.

Originality. For the first time a test model has been suggested and a list of parameters and level of long-term constructional properties have been defined for the material of emergency support of wheel running gear of cargo vehicle under compressive load. We have defined the mechanism of combined mechanical and physical contact between fibrous filler and polymer matrix, which gives us the possibility to make predictable changes of long-term constructional properties of thermoplastic composite.

Practical value. The design of the thermoplastic polymer composite produced from fresh and secondary raw materials has been tested for its technological appropriateness for development of the emergency support for upgrading the cargo vehicle wheel running gear with pneumatic tire 365/80R20 140K.

Keywords: *safe movement, emergency support of wheel running gear, thermoplastic polymer composite*

An introduction, indicating article’s scientific problem and analysis of the recent research and pub-

lications. It seems to be unwise to assess damages from possible loss of human life and health in the traffic accidents caused by the sudden damage of pneumatic tires since this can be avoided by upgrading the traditional

pneumatic-tired wheel of vehicles with special emergency support providing the desired traffic safety. Despite the technical solution is relatively simple [1, 2], its practical implementation requires to solve a lot of constructional and technological conflicts caused by the lack of commercially attractive constructions of the emergency support at the market.

Besides purely humanitarian considerations, especially in today's increasingly growing requirements for resource and environmental advanced products, and the more additional items to already common designs, technical and economic component implementation of this decision has essential value. So, upgraded with special emergency support our pneumatic-tired wheel must keep operational properties at stationary rolling and appropriate reproduce during emergency rolling. Since such emergency support is an additional element, so it increases the attractiveness depending on success issues - preserving of reparability of damaged tires to further exploitation and of finding the universal material with minimal density which allows us to avoid the use of reinforcing elements in the design and realize the benefits of recycling.

Unsolved aspects of the problem. Under these conditions, it becomes principally impossible to consider any rubber as a construction material of emergency support, which is a traditional reaktoplastic polymer composite for tire products [3]. It is the reaktoplastic structure which does not allow realizing the benefits of recycling, while providing acceptable properties for use in multiple tire products, tires.

Previously made systematic materials research of thermoplastic polymers [4, 5], which on the structure can realize the benefits of recycling, provided fundamental understanding relatively the possibility of using them for making emergency support. In these circumstances, prerequisites are provided to solve the questions not only in traffic safety, but also in production, operation and disposal ecology. In accordance with the above considerations, [6] unpneumatic performance of emergency support (Fig. 1) looks more appropriate, it requires a revision of traditional criteria for investigation of polymers.

Although for many decades, there are common methods of physical and mechanical studies of polymeric materials [7], the use of which requires compliance of regulated impacts, their results provide an opportunity to make a correct comparative conclusions. While for the calculation the product requires knowledge of numerical level of constructional parameters of material at a load approached to operational one, this does not conform to generally accepted methods of physical and mechanical studies.

In the absence of any systematic data on similar objects and conditions of their loads, it was offered to provide safe pneumatic-tired wheel both as calculation and experimental model, to define conditions of the loading under static and dynamic compression (Fig. 2). We consider the example of emergency support for retrofit pneumatic-tired wheel 365/80R20 140K of cargo vehicles.

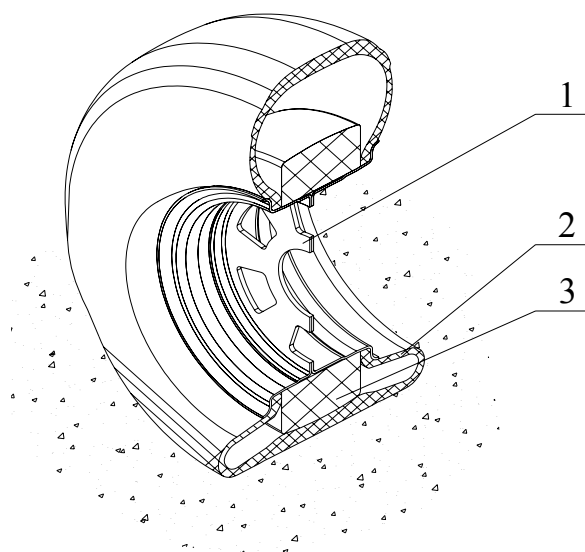


Fig. 1. Safe pneumatic-tired wheel in an emergency, where: traditional wheel rim (1), traditional pneumatic tire in damaged condition (2), unpneumatic emergency support (3)

According to the terms of loading of the emergency support, the result of measurements of the object is given in the form of thick-walled cylinder by established empirical relationship to measurements on standard cylinder [8]; we have found conditions, list and level of parameters of long-term constructional properties of material compression to:

- elastic-hard properties which are summarized by the conventional modulus of elasticity ($E_{sup.}$, MPa), providing the ability to predict the level and change the kinematics of pneumatic-tired wheel in emergency static tiredness (Fig. 2, a) and dynamic (Fig. 2, and considering Fig. 2, b);

- absorptive capacity, which is generalized by the indicator of hysteresis ($H_{sup.}$, rel. units.), providing the ability to predict changes in level of comfort of pneumatic-tired wheel in an emergency dynamic tiredness (Fig. 2, b);

- long-term resistance, which is generalized by the indicator of relaxation of tension ($\sigma(t)$, MPa), providing the ability to predict preservation traction capacity of pneumatic-tired wheel in static emergency load for the duration of the guaranteed service life of tire (Fig. 2).

Analysis according to the criterion of dynamic tiredness in rubber compression of cargo tires in damaged condition, allows to define the desired level of indicator $E_{sup.}$ (Fig. 2, a) avoiding its destruction and preserving reparability for further use after the emergency rolling. By the criterion conditional tension of contact $\sigma_{cont.} = 1.5$ MPa and a geometrical factor of emergency support, for which parameter of relative deformation is $\varepsilon_{sup.} = 2.5\%$, the material required for emergency support level of indicator is $E_{sup.} \geq 59.2$ MPa, which is almost an order greater than the possibility of traditional rubber.

Movement of cargo vehicle (Fig. 2, b) in the stationary state (speed indicator of stationary rolling $V_{s,r}=110$ km/h) does not provide the load of emergency support, whereas it provides movement in emergency condition (speed indicator of emergency rolling $V_{e,r}=40$ km/h). The level of indicator $E_{sup.}=59.2$ MPa calculated by standard level of indicator loading speed $v=100$ mm/min, whereas in practice $V_{e,r}$ index = 40 km/h corresponds to level of parameters frequency of load $\nu \approx 5$ Hz and loading speed $\nu \approx 1400$ mm/min.

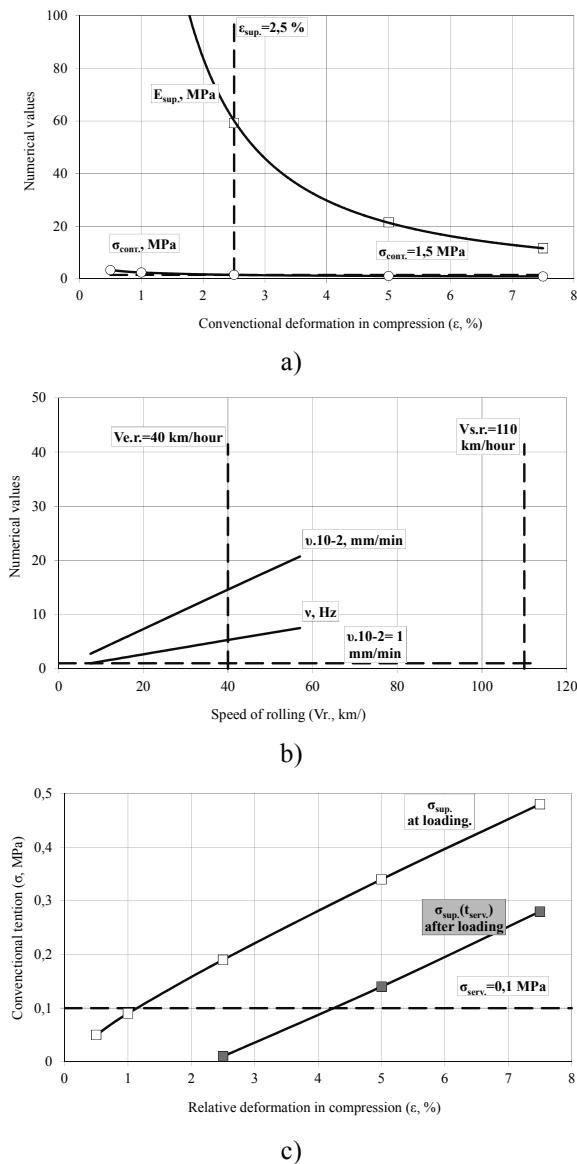


Fig. 2. Parameters in compression material of emergency support: (a) conventional modulus of elasticity ($E_{sup.}$, MPa) in tension of contact $\sigma_{cont.}=1.5$ MPa and relative deformation $\epsilon_{sup.}=2.5\%$, (b) the frequency of loading (ν , Hz) and loading speed (v , mm/min) during emergency rolling with speed $V_{e,r}=40$ km/h prolong $t_{e,r}=1$ h and relative deformation $\epsilon_{sup.}=2.5\%$, (c) relaxation of tension ($\sigma(t)$, MPa) for a guaranteed lifetime tire $t_{serv.}=5$ years

Presented loading conditions of emergency support allows us to predict the change of kinematics and comfort pneumatic-tired wheel, according to the change of elastic-hard properties and absorption capacity of the material, only during rolling in emergency condition (indicators: $V_{e,r}=40$ km/h and the term emergency rolling $t_{e,r}=1$ hour).

For traditional pneumatic tires the ability to be used during five years, is provided, following the rules of service and avoiding mechanical damage when saving traction capacity of the tread, which is reflected by the indicator of guaranteed lifetime $t_{serv.}=5$ years. If pneumatic-tired wheel is upgraded with the emergency support, relaxation properties of the material (Fig. 2) should ensure avoidance of displacement on the rim of pneumatic tire, regardless of condition, providing sufficient long-term resistance. The ability to avoid displacement of the pneumatic tire and emergency support at the rim is defined by the indicator of the conditional tension for a guaranteed term $\sigma(t_{serv.}) \geq 0,1$ MPa. On this occasion, the suitability of the application of material for emergency support of pneumatic-tired wheel for cargo vehicle must be investigated, simulating operational requirements, subject to compressive load by the following combination of factors influencing the experimental samples:

- $v=100 \div 1400$ mm/min, which corresponds $V_{e,r}=4 \div 40$ km/h at $\nu=1 \div 5$ Hz;
- $N=1 \div 18000$ cycle. if $\epsilon=2,5\%$ and $\nu=5$ Hz, corresponding $V_{e,r}=40$ km/h at $t_{e,r}=1$ h;
- $v=100$ mm/min. if $\epsilon=2,5\%$ and $t=3600$ s, when the corresponding $\sigma(t_{serv.}) \geq 0,1$ MPa.

Presentation of the main research and explanation of scientific results. In the absence of universally recognized material for emergency support, functional polymers acceptability when comparing with rubber, the reaktoplastic polymer composite, traditional for tire products. As thermoplastic polymers, polyamid (PA), polyethylene (PE) and polypropylene (PP) were considered as per the prevalence of use. Functional acceptability of the material was evaluated by scoring $1 \div 4$, and if there's 0, its use is unreasonable (Table 1).

According to the requirements for selection of material of the emergency support the following is unacceptable: for rubber there is a reaktoplastic structure that makes impossible the implementation of recycling, with insufficient level of elastic-hard properties, for PA it is too high density, PE has too small long-term resistance. PP (28 points) was elected, which has an extraordinary attractiveness by the density, elastic-hard properties at low energy recycling. However, its usage is caused by the need to solve some complex constructional-technological issues – reducing the elastic-hard properties and increase of absorption capacity while preserving sufficient long-term resistance.

Table 1

Comparison of the physical-mechanical testing of polymeric materials

Conditions of testing	rub-ber	Thermoplastic poly-mer materials		
		PA	PE	PP
Physical properties, functional scores				
Density	2	1	3	4
Temperature of processing	1	4	2	3
The physical scores	3	5	5	7
Constructional properties, functional scores				
Parameter E in compression $\epsilon=0,5\div7,5\%$ and $v=100\text{ mm/min}$	0	3	2	4
Parameter E in compression $\epsilon=2,5\%$ and $v=1\div5\text{ Hz}$	0	3	2	4
Parameter E in compression $\epsilon=2,5\%$, $v=5\text{ Hz}$, $N=1\div18000\text{ cycles.}$	0	2	3	4
Parameter H in compression $\epsilon=2,5\%$ and $v=1\div5\text{ Hz}$	4	2	1	3
Parameter H in compression $\epsilon=2,5\%$, $v=5\text{ Hz}$, $N=1\div18000\text{ cycles.}$	4	2	1	3
Parameter $\sigma(t_{serv.})$ in compres- sion $\epsilon=2,5\%$ and $v=100\text{ mm/min}$	0	4	0	3
The constructional scores	8	16	9	21
The functional acceptability, scores	11	21	13	28

Obtaining an acceptable complex of constructional and technological properties in compression for PP, it is offered to implement in the case of creation on its base of thermoplastic polymer composite (TPC) in the above-mentioned polymer matrix (PM) and fibrous filler (FF). At the same time preservation of attractive technological properties of TPC, that retain the ability to recycling, provides compliance with specific requirements for the chosen FF, the chemical inertness to the PM.

In establishing and understanding the empirical influences on the properties of TPC and considering the possibility of components with different levels of parameter density (ρ , kg/m³), it was suggested to manage at the same time on two grounds contents: the weight (CTPC, wt.%), considering as a technological system and volume (VTPC, vol.%), considering as a mechanical system

$$CTPC = CPM + CFF \text{ та } VTPC = VPM + VFF,$$

where CTPC, CPM, CFF – the weight content TPC, PM, FF; VTPC, VPM, VFF – the volume content TPC, PM, FF.

In order to avoid the influence of geometric factor FF chosen with similar dimensions (Table 2), anid fiber (AnF), polymeric nature of which causes smooth surface relief, with the near level by parameter ρ of PP, whereas twice as much level of a basalt fiber (BF), mineral nature of which provides rough relief.

The presence of AnF or BF in the TPC, subject to adherence the same level of CFF demonstrates the difference almost twice in the level of VFF, which must be accompanied in accordance with the difference between the

level of calculated contact area PM-FF. However, [9] from experimental data changes in the level and nature of relationships, except ρ , have the opposite of expectations if there is only one variable factor – the state of the surface relief FF.

Table 2

Physical and geometric properties of components TPC for weight and volume content

Compo-nents of TPC	Density of compo-nents (ρ , kg/m ³)	Diameter FF (d, mkm)	Content of components TPC weight / volume (C, wt. % / V, vol. %)
PP	900	-	100÷70 / 100÷75
AnF	1140	13	0÷30 / 0÷25
BF	2300	14	- / 0÷30 / 0÷14

The gradual change by the weight content of the TPC demonstrates display the following trends:

- index ρ (Fig. 3, a), the level of which depends entirely on the physical properties of components and varies only in proportion to their content, the storage requirements low density, it is appropriate to use FF polymeric nature;

- index E (Fig. 3, b), whose level in the presence of BF, unlike AnF differently changes at the beginning and after tiredness, by staying too large as the level and the difference, so the requirement to reduce the level of elastic-hard properties should have FF with smooth relief;

- index H (Fig. 3, c), whose level in the presence of AnF, unlike BF, changes in different ways at the beginning and after tiredness, staying too large as the level and their difference, so the requirement to increase the absorptive capacity should have FF with rough relief;

- index $\sigma(t)$ (Fig. 3, d), whose level in the presence of BF, unlike AnF differently varies with load and after it, by staying by the a sufficient level at twice smaller weight content, but at a much greater difference, therefore, for requirement to preserve a sufficient level of long-term resistance should have FF with rough relief.

Presented empirical dependences allow summarizing the influence of the surface relief of inert FF on elastic-hard properties, absorption capacity and long-term resistance in compression, by suggesting following mechanisms of combination mechanical and physical contact PM-FF.

FF with smooth relief forms mainly physical-mechanical connection with PM, which slows the thermomechanical destruction of components of the TPC. This is indicated, with increasing FF content fundamentally the same change trends in level of E, regardless of loading cycles, and fundamentally opposing change trends in level of H, depending on the loading cycles, σ and $\sigma(t_{serv.})$.

FF with rough relief forms a transitional value of Mechanical-physical to physical-mechanical connection with the PM, which activates the thermomechanical destruction of components TPC. This is indicated fundamentally opposing change trends in the level of E, depending on the loading cycles, and fundamentally the same change trends in the level of D, regardless of cycles, σ and $\sigma(t_{serv.})$.

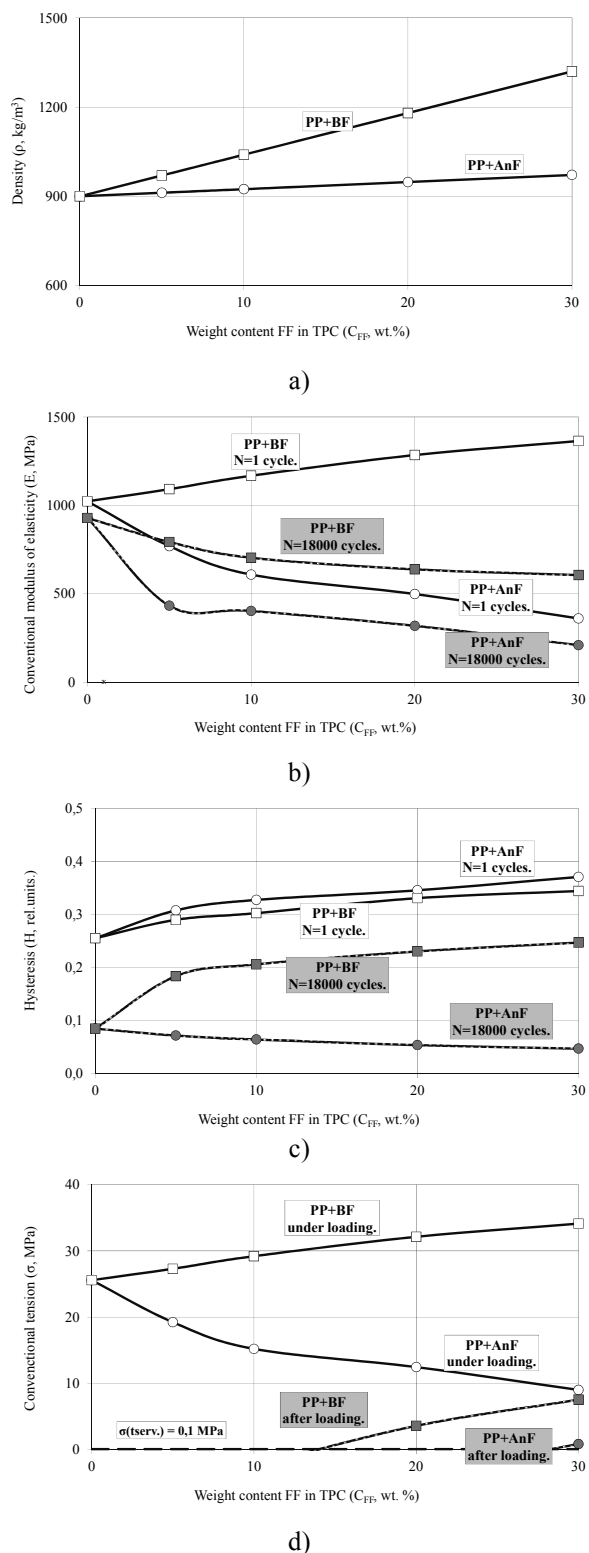


Fig. 3. Parameters TPC depending on the weight content FF (C_{FF} , wt.%) - BF or AnF, where: a) density (ρ , kg/m³); b) conventional modulus of elasticity in compression (E, MPa) and c) hysteresis in compression (H, rel. units.) in the beginning (N = 1 cycle.) and after (N = 18 000 cycles). tiredness $\varepsilon = 2.5\%$ and $\nu = 5$ Hz; d) conditional tension relaxation in compression ($\sigma(t)$, MPa) at the beginning and after (forecast $t_{serv} = 5$ years) the load $\nu = 100$ mm/min, $\varepsilon = 2.5\%$ relative to $\sigma(t_{har}) = 0.1$ MPa (dotted line provided)

Thus, empirically given the opportunity to provide an acceptable complex of constructional-technological properties of the TPC (relative to the PM reduce the level of E, increase the level of H and conservation level of $\sigma(t)$) in accordance with the state of the surface relief FF. Dependence reproduces the mechanism of combination of mechanical and physical contact PM-FF, but that does not affect the density of the TPC, which is due to the physical properties of selected FF.

Assuming the absence of restrictions in the general application of the above mechanism combination of mechanical and physical contact PM-FF, while creating that is regardless of the nature of the filler, TPC and trying to avoid the influence of excessive level of ρ for FF with rough relief an attractive looks search options for creating FF polymeric nature with rough relief.

Developed means of providing the relief rough to smooth surface FF of polymeric nature, based on AnF, according to which under suitable constructional-technological properties is the lowest level of ρ . Artificially produced anid fiber with rough relief (AnF + A), the first FF polymeric nature with expected relief, almost no changes in ρ purposefully gives TPC the desired complex of long-term constructional properties.

Studies the preserving of acceptable ability TPC principal composition PP + (AnF + A) to recycling provided by three times (1 → 2 → 3) consistently carried out at constant processing technology and composition.

Increasing of weight content (AnF + A) in the TPC at 1 and 3 processing, under conditions of compression at the beginning and after dynamic tiredness and static load, demonstrates the display of the following trends:

- index ρ (Fig. 4, a), the level of which depends entirely on the physical properties of components and varies only in proportion to their content, provided close level for all applicable components of the density of the composite remains almost unchanged;

- index E (Fig. 4, b), which level is regardless of the number of recycles equally changes at the beginning and after tiredness, gradually reduced the level and difference that meets the requirements for reduce the level of elastic-hard properties;

- index H (Fig. 4, c), which level is regardless of the number of recycles equally changes at the beginning and after tiredness, gradually increases by the level and decreases the difference that meets the requirements for increase the level of absorptive capacity;

- index $\sigma(t)$ (Fig. 4, d), which level is regardless of the number of recycles equally changes with and after the load, gradually remains sufficient by the level with less difference and almost twice smaller weight content (AnF + A) than AnF (Fig. 3, d), which meets the requirements for by the saving a sufficient level of long-term resistance.

Research conclusions. Based on the generalization of research constructional-technological properties of TPC considered according to the detected dependencies predicted impact of offered specific recommendations for the effective use of materials science capabilities in developing emergency support for the safe operation and environmental of pneumatic-tired wheel.

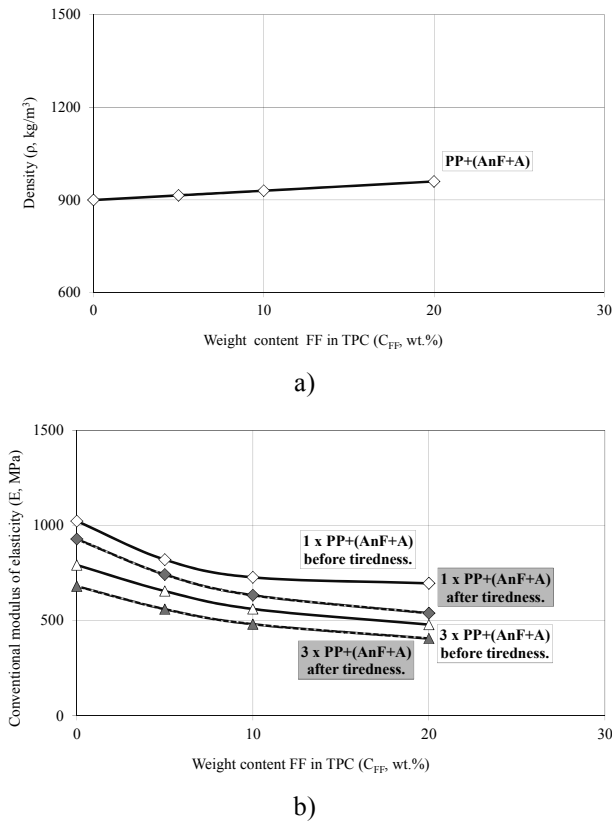


Fig. 4, a, b. Parameters TPC depending on the weight content of FF (C_{FF} , wt.%) polymeric nature with rough relief (AnF + A) and amount of consecutive recycling (the first - and third 1x - 3x), where: a) density (ρ , kg / m³), b) conventional modulus of elasticity in compression (E , MPa)

Kinematics of pneumatic-tired wheel with a damaged pneumatic tire provides elastic-hard properties of TPC, which, despite their decreasing while the creation, remain excessive.

In such circumstances it is appropriate in an array of emergency support to perform the appropriate by volume and shape cavity or cavities that allow making the desired redistribution of the load, providing the desired level of relative deformation, and significantly ease the design.

Comfort of pneumatic-tired wheel with a damaged pneumatic tire is provided by absorbing ability TPC that while creating almost identical to its level for the rubber, the traditional material of tire products. If it is necessary to increase the comfort of the emergency support, you should increase the level of relative deformation that, by analogy with constructional means for changing kinematics can also be achieved by the implementation of the array corresponding by volume and shape of the cavity or cavities.

Integrity of pneumatic-tired wheel with a damaged tire is provided by long-term resistance TPC which while creating is not only maintained at a sufficient level, and even significantly increased. Within needs of transmission torque and braking force when there is no displace-

ment on the rim it allows us to consider the possibility of execution of the cavity or cavities without any restrictions in any part of the array of emergency support.

The safety of pneumatic-tired wheel with a damaged tire provides enough capacity TPC for long-term excerpts static and dynamic compression, saving from destruction array of emergency support in conditions of emergency operation. Thus, following the appropriate limits on contact loads in compression for rubber provides preservation damaged tires not only from the final destruction and fire, and even further exploitation after proper repair.

Environmental friendliness of pneumatic-tired wheel with a damaged tire provides preservation TPC while creating thermoplastic structure. If using a unified TPC for making the entire array of emergency support, avoiding the use of any embedded structural elements, is almost unlimited capacity for recycling.

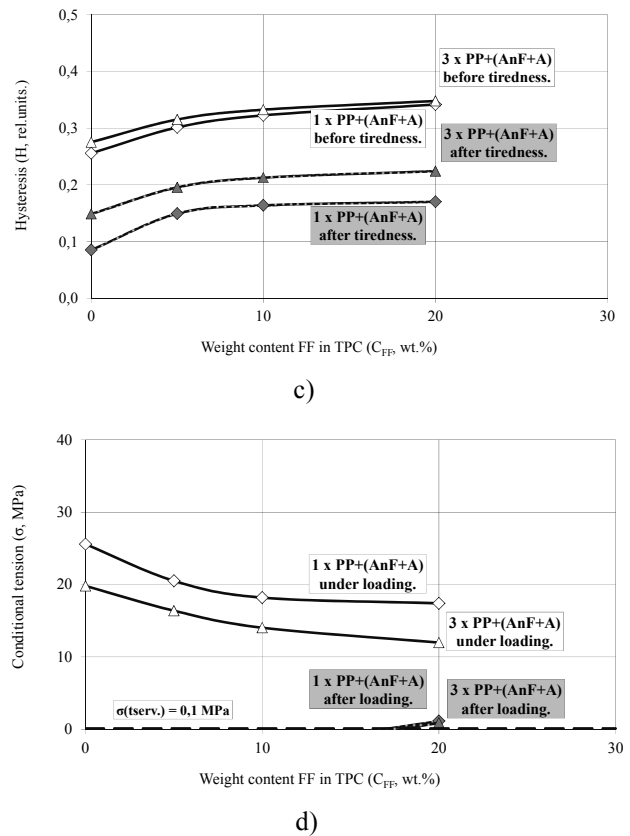


Fig. 4, c, d. Parameters TPC depending on the weight content of FF (C_{FF} , wt.%) polymeric nature with rough relief (AnF + A) and amount of consecutive recycling (the first - and third 1x - 3x), where: c) hysteresis in compression (H , rel. units) in the beginning ($N = 1$ cycle) and after ($N = 18\ 000$ series) tiredness $\epsilon = 2.5\%$ and $\nu = 5$ Hz; d) relaxation of the conditional tension in compression ($\sigma(t)$, MPa) at the beginning and after (forecast prolong $t_{serv.} = 5$ year) the load $\nu = 100$ mm / min, $\epsilon = 2.5\%$ relative to $\sigma(t_{har.}) = 0.1$ MPa (dotted line provided)

Since the recycling is undertaken, levels of E and σ ($t_{serv.}$) gradually reduce, with increasing H desirable according to the number of executed recycles, gradually reduce the volume or shape of the cavity or cavities in the array of emergency support.

The damaged tire, saved for repairs and further operation, does not require resources to manufacture new tires or for the disposal of the old one. Using TPC for developing emergency support is even inappropriate to make comparisons with the negative impact on the environment and too large resource intensity of manufacturing processes and recycling of pneumatic tires.

Thus, providing for the safe operation and environment traditional pneumatic-tired wheel allows avoiding many problems of retrofitting with special emergency support of thermoplastic polymer composites created by the special list of constructional-technological properties.

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Мета. Розробка засобів створення термопластичного полімерного композиту з довготривалими конструкційними властивостями для безпечної експлуатації шинних виробів та екологічних умов їх виробництва.

Методика. Для досягнення поставленої мети були використані наступні методи дослідження: стандартні та модельні фізико-механічні випробування композиту при довготривалому статичному й динамічному навантаженні при стисненні в лабораторіях ДВНЗ „Український державний хіміко-технологічний університет“ та ВАТ „Дніпрошина“ (Україна), мікроскопічні дослідження в лабораторіях „Національного технічного університету Франції“ (м. Сент-Етьєн).

Результати. Розглянуто функціональну доцільність дооснащення традиційного колісного рушія спеціальною аварійною опорою для забезпечення

безпеки руху вантажних транспортних засобів у разі пошкодження пневматичної шини. Відповідно до сучасних вимог ресурсозбереження та екологічності при створенні новітніх виробів, а тим більш додаткових елементів для вже поширених конструкцій, окрім безумовної потреби прийнятного відтворення експлуатаційних властивостей у стані аварійного кочення колісного рушія, він повинен зберігати ремонтпридатність пошкодженої шини та здатність, по можливості, до необмеженого рециклінгу. Матеріалознавчі дослідження дозволили обґрунтувати застосування спеціально створеного термопластичного полімерного композиту при розробці аварійної опори, на відміну від неприйнятної для цього традиційного реактопластичного полімерного композиту шинних виробів – гуми. Особливий перелік конструкційно-технологічних властивостей дозволяє уникнути багатьох проблем виробництва, експлуатації та переробки, однак потребує конструкційних рішень аварійної опори, що уникають застосування армуючих елементів.

Наукова новизна. Уперше запропоновано розрахунково-експериментальну модель та означено перелік і рівень показників довготривалих конструкційних властивостей за умов навантаження при стисненні матеріалу аварійної опори колісного рушія вантажного транспортного засобу. Визначено механізм поєднання механічного та фізичного контакту волокнистого наповнювача з полімерною матрицею, на підставі якого встановлена можливість прогнозованої зміни довготривалих конструкційних властивостей термопластичного композиту.

Практична значимість. Проведено випробування конструкційно-технологічної придатності створеного термопластичного полімерного композиту з первинної та вторинної сировини при розробці аварійної опори для дооснащення колісного рушія з пневматичною шиною 365/80R20 140K вантажних транспортних засобів при використанні їх для перевезення вантажів у гірничій, будівельній та інших галузях промисловості.

Ключові слова: *безпечний рух, аварійна опора колісного рушія, термопластичний полімерний композит*

Цель. Разработка способов создания термопластичного полимерного композита с долговременными конструкционными свойствами для безопасной эксплуатации шинных изделий и экологических условий их производства.

Методика. Для достижения данной цели были использованы следующие методы исследования: стандартные и модельные физико-механические испытания композита при долговременном статическом и динамическом нагружении при сжатии) в лабораториях ГВУЗ „Украинский государственный химико-технологический университет“ и ОАО „Днепрошина“ (Украина), микроскопические исследования в ла-

боратории „Национального технического университета Франции“ (г. Сент-Этьен).

Результаты. Была рассмотрена функциональная целесообразность дооснащения традиционного колесного движителя специальной аварийной опорой для обеспечения безопасности движения грузовых транспортных средств, в случае повреждения пневматической шины. Согласно современным требованиям ресурсосбережения и экологии при создании новейших изделий, а тем более дополнительных элементов для уже распространенных конструкций, кроме безусловного требования приемлемого восстановления эксплуатационных свойств в состоянии аварийного качения колесного движителя, аварийная опора должна сохранять ремонтпригодность поврежденной шины и способность, по возможности, к неограниченному рециклінгу. Материаловедческие исследования позволили обосновать применение специально созданного термопластичного полимерного композита при разработке аварийной опоры, в отличие от неприемлемого для этого традиционного реактопластичного полимерного композита шинных изделий – резины. Специфический перечень конструкционно-технологических свойств позволяет исключить многие проблемы производства, эксплуатации и переработки, однако требует конструкционных решений аварийной опоры, которые исключают использование армирующих элементов.

Научная новизна. Впервые предложена расчетно-экспериментальная модель и обозначен перечень и уровень показателей долговременных конструкционных свойств в условиях нагружения при сжатии материала аварийной опоры колесного движителя грузового транспортного средства. Определен механизм объединения механического и физического контакта волокнистого наполнителя с полимерной матрицей, на основании которого установлена возможность прогнозирования изменений долговременных конструкционных свойств термопластичного композита.

Практическая значимость. Проведены испытания конструкционно-технологической приемлемости созданного термопластичного полимерного композита на основе первичного и вторичного сырья при разработке аварийной опоры для дооснащения колесного движителя с пневматической шиной 365/80R20 140K грузовых транспортных средств при использовании их для перевозки грузов в горной, строительной и других отраслях промышленности.

Ключевые слова: *безопасное движение, аварійна опора колесного движителя, термопластичний полімерний композит*

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