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EVALUATION OF ECOLOGICAL IMPACT OF ROADS FUNCTION OF THEIR TECHNICAL CONDITION AND THE INTENSITY OF TRAFFIC FLOW (II)
PRACTICAL APPROACH. CASE STUDIES AND TECHNICAL RECCOMNADATIONS

BY

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Abstract. The first part of the paper, Part one, after describing the main environmental indicators and various chains of causality taken into account for the evaluation of the negative ecological impact of roads, presents the influence of pavement condition, including distresses and roughness and the intensity of traffic flow on the environment. Based on the theoretical investigation conducted in Part one, in the second part of the paper, Part Two, specific environmental classes of impact have been conceived and proposed, in order to be used in practice for the evaluation of actual ecological status of road transport system. Finally, technical recommendations for reducing the actual levels of ecological impact, based on the results of significant case studies conducted on national road NR 28 are presented.

Keywords: pavements; road roughness; pavement condition; ecological impact; traffic intensity.

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1. Introduction

Based on the investigation of the influence of pavement condition and traffic intensity and on the description of the environment indicators and their corresponding chains of causality developed in Part 1, in this second Part of the paper, specific research considering the definition of various classes of impact is presented. Further, technical recommendations for the use of classes of impact for evaluation of actual ecological status of the road transport system involving National Road NR 28, including all its components (fixed plant infrastructure, rolling stock and its management scheme) are given in order to reduce this negative impact.

2. The Impact Classes of Road Infrastructure

The need to establish specific criteria for fitting a particular sector of the road into an ecological impact class derives from the increasing degree of atmospheric pollution that leads to the amplification of global warming. Establishing environmental impact classes will allow identifying critical road sectors in order to further prioritize and subsequently adopt appropriate prevention and mitigation measures. Also, these environmental impact classes can be used from the road design phase to select the best alternative of the route from a technical, economic and environmental point of view, as well as establishing measures to prevent the impact associated with construction and maintenance of the road, thus these classes becoming an important tool in decision-making processes (Condurat, 2016). In the field of roads, the environmental impact classes depend to a large extent on the average daily traffic intensity, the technical pavement condition of the road, its geometrical characteristics, the vehicle fleet as well as the speed of the vehicles. However, the volume of traffic and the technical pavement condition of the road have the most influence in the discussed context. Therefore, the technical parameters with an indirect influence on the surrounding environment refer to the longitudinal evenness correlated with the atmospheric pollution and vibrations, the pavement roughness related to the noise pollution, as well as the surface distresses, which lead to the increase of vibration level. Technical parameters specific to the pavement condition of roads with a major influence on environmental impact classes are the International Roughness Index – IRI, Pavement Condition Index – PCI, and Present Serviceability Index – PSI. In connection with Fig. 1, seven Ecological Impact Classes - EIC established in accordance with the values of the PCI, PSI, IRI indices, highlighting the effect of the technical pavement condition on the environment, have been defined and proposed to be used in practice (Condurat, 2016). These environmental impact classes can be a useful tool in decision-making, helping the manager decision-makers to prioritize rehabilitation work. Impact classes can also be used to identify critical areas for urgent implementation of intervention strategies to mitigate and compensate the produced negative effects. Another use of the impact classes is to anticipate the ecological effects correlated with the evolution of the road performance curve and to select those intervention strategies that produce a significant extension of the lifetime combined with the most advantageous costs and the lowest environmental impact.

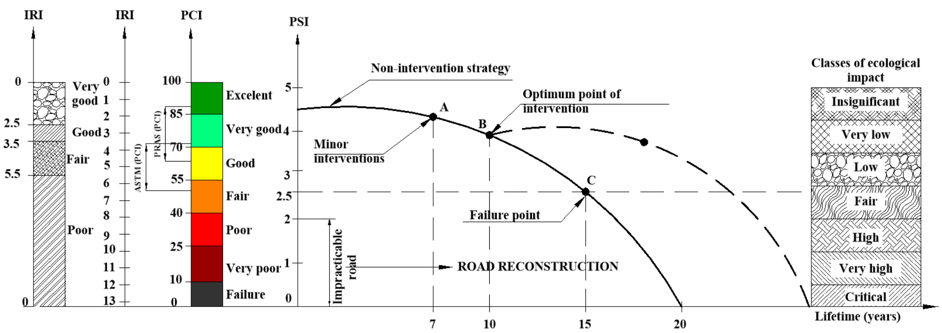

Fig. 1 – The correlation between the pavement condition of the roads and the associated ecological impact classes.

As can be seen from Fig. 1, the environmental impact classes have been developed in accordance with the ratings established for the PCI index in ASTM D6433-07 "Standard Practice for Roads and Parking Lots Pavements".

3. Evaluation of Ecological Status of an Experimental Road Sector from National Road NR 28 Case Studies

3.1. Evaluation of the Impact of Pavement Condition

In order to evaluate its ecological status of the national road NR 28 between km 14 + 770 and 17 + 145, a technical inspection of the entire route, completed with its division into homogeneous sections characterized by similar values of road structure, hydrological regime, climate type and traffic have been undertaken. The pavement condition of the road section has been determined based on the PCI numerical indicator, which has been designed in order to rate the surface condition of a road pavement, and also the structural integrity and surface operational conditions (ASTM D 6433-07). For each homogeneous sector, representative samples have been selected, based on a visual inspection of the road. Further, a survey sheet has been developed for each pavement sample unit which contains the type, length and severity for the distresses on that particular sample. Next, according to the procedures indicated by ASTM D 6433-07, the total quantity for each distress with the same severity degree and their corresponding deduct values have been computed. Further, based on the corrected deduct value (CDV), calculated according with ASTM 6433-07, the PCI indicator has been determined. The distress taken into account for the assessment of the pavement condition are presented below in Figs. 2,...,4.

Fig. 2 – Distresses on Sample E1.

Fig. 3 – Distresses on Sample E2.

Fig. 4 – Distresses on Sample E3.

Based on the results obtained from the pavement condition assessment through visual investigations one may observe that the analyzed road sectors present bad and very bad characteristics for vehicle traffic. This section of the national road NR 28 shows a series of distresses with a high degree of severity which, if not remedied, can compromise the resistance of the pavement structure, the costs associated with its structural reinforcement and reconstruction being much higher.

Table 1 presents the centralized results of the pavement condition used for road NR 28 Săbăoani-Iaşi-Albiţa, based on the identified distresses.

Table 1
Distress survey for road samples

DATA SHEET FOR INVESTIGATING THE PAVEMENT CONDITION FOR A ROAD SAMPLE													
1.Aligator cracking 2. Bleeding 3. Transverse and block cracking 4. Bumps and sags 5. Corrugations		6. Depressions 7.Edge cracking 8. Joint reflection cracking 9.Shoulder drop off 10. Longitudinal and transverse cracking				11. Patching-utility cuts 12. Polished aggregates 13. Potholes 14. Railroad crossing 15. Rutting					16. Shoving 17.Slippage cracking 18.Swell 19. Weathering and ravelling		
Type and severity	Units	QUANTITY									Total	Density%	Deduct value
#1L	m^2	1.5x0.8									1.2	1.14	**11.26**
#1M	m^2	3.6x0.8	3.0x0.8								5.28	5.03	**38.15**
#1H	m^2	10.2x0.8									8.16	7.77	**58.13**
#10L	m	0.8	0.6	0.9	0.9	2.1					5.3	5.05	**3.27**
#10M	m	3.0	1.5	1.3	1.1	0.9	0.6	2.0	1.7	1.2	13.3	12.67	**20.00**
#10H	m	3.0	1.8								4.8	4.57	**21.70**
#13L	nr.	2									2	1.90	**28.00**
#13M	nr.	1									1	0.80	**30.00**
#15L	m^2	12.0									12.0	11.43	**27.60**
Road sample E1 → PCI = 100 - maxCDV = 100 - 87.2 = 12.8Þ Pavement condition - Very bad													
#1M	m^2	2.1x0.8									1.68	1.6	**24.2**
#1H	m^2	3.0x0.8	9.4x0.8								9.92	9.45	**61.6**
#10L	m	1.8									1.8	1.71	**0.0**
#10M	m	3.2	2.0	3.5							8.7	8.29	**15.5**
#10H	m	2.9	2.8								5.7	5.43	**23.3**
#12L	m^2	0.9x4.5									4.05	3.86	**0.0**
#19L	m^2	1.5x5.1	1.8x7.5								21.15	20.14	**7.4**
Road sample E2 → PCI = 100 - maxCDV = 100 - 71.1 = 28.9 Þ Pavement condition - Bad													
#1M	m^2	2.7x0.8									2.16	2.06	**27.7**
#3M	m^2	2.7x0.7	2.4x1.5	2.4x1.5							9.09	8.66	**15.7**
#3H	m^2	2.4x2.0									4.8	4.57	**20.0**
#10L	m	1.8	2.4	1.2	1.3	1.1					7.8	7.43	**5.5**
#10M	m	2.5	3.0								5.5	5.23	**11.3**
#10H	m	3.5									3.5	3.33	**18.1**
#11M	m^2	0.5x10.5									5.25	5.00	**21.4**
#12L	m^2	8.1x1.2	8.2x1.1								18.74	17.85	**6.2**
#19L	m^2	7.5x1.6	5.4x1.6								20.64	19.66	**7.4**
Road sample E3 → PCI = 100 - maxCDV = 100 - 61.1 = 38.9 Þ Pavement condition - Bad													

Table 2 presents the centralized results of the pavement condition used for road NR 28 Săbăoani-Iaşi-Albiţa, as well as their corresponding environmental impact class.

Table 2
Pavement Condition Associated with the Analyzed Samples from NR 28. Ecological Impact Classes (Condurat *et al.*, 2016)

Sample	ASTM PCI	Ecological impact class
E1	**12.8**	**Critic**
E2	28.9	Very high
E3	38.5	High

The E1 road sample, located on the homogenous sector 1, at the km 14 + 770, shows the highest distresses with a degree of severity pointing to a very bad pavement condition. In this situation, taking into account the evolution of its distresses, correlated with the PCI and PSI indicators presented in Fig. 1, the analyzed section of the road is considered as impracticable. The value of the PCI indicator in this case is 12.8, which means that from an ecological point of view is ranked in the Critical Impact Class. The PCI indicator for the other two samples analyzed are Bad, the PCI for road sample E2 being equal to 28.9 and respectively for E3 being 38.5. These values, viewed in terms of sustainability, are found in the Very High Ecological Impact Class. These environmental impact classes, corroborated with the traffic safety and comfort criteria, transposed by the signs of distress, evenness, roughness and bearing capacity, testify to the need to apply specific rehabilitation strategies for the analyzed sector. In this respect, the section has been prioritized, on this basis and maintenance works needs to be programmed and executed meanwhile.

3.2. Evaluation of the Influence of the Composition and Intensity of the Traffic Flow

This case study emphasises the significant increase of the greenhouse gas effect and also fuel consumption due to the traffic flow. Based on the results obtained, specific strategies, required for an improvement of road network sustainability, are presented. The analysis performed within this paper requires a quantitative assessment of CO_2 emissions and also energy consumption due to road traffic on NR 28. In this regard, a comprehensive assessment of atmospheric pollution produced by the road traffic, has been undertaken. In order to highlight the importance of intervention strategy for an ecological point of view, the case study focus on two scenarios. For the first scenario, the ecological impact associated with the road traffic has been determined based on the actual road network pavement condition, presented previously. The second one is the ideal situation regarded from traffic sustainability perspective, when the road pavement has been properly rehabilitated, at an optimum moment. In this scenario the vehicles speed does not depend on the pavement condition and thus the road service level is free flow. The results obtained using the European Environment Agency (EEA) computer software COPERT 4 consists in the pollution level, associated with County of Iaşi road network. As mention before, this analysis has been performed using the software COPERT 4, which has been designed to determine the pollutant emissions associated with road transportation, but also for the analysis of fuel consumption (Gkatzoflias et all, 2012). The specific input data necessary for this analysis refers to the minimum and maximum monthly average temperatures and relative humidity within the month, characteristics and annual fuel consumption, the rolling stock recorded on the road sector, fleet mileage and movement speed. The vehicle fleet is divided first by vehicle category in passenger cars, heavy vehicles, light commercial vehicles, buses and motorcycles. Secondly, each group of vehicles is segmented by size class and technology, emission concept and type of fuel used (Gkatzoflias *et al*., 2012). Table 2 synthesizes the results obtained from the analysis conducted with COPERT 4 software for the national road NR 28 in the first scenario. According Table 3, the highest quantity of emissions has been recorded in Sector 3, which has a total length of 22.450 km and a road traffic of AADT = 20,542 standard vehicles.

Table 3

Pollutant emissions due to road traffic on NR 28 for the actual road pavement condition (Condurat *et al*., 2016)

Road	Sector	Kilometric position	Sector length km	CO t	CO_2 t	FC t	NO_x t	PM t
DN 28	Sec. 1	7.100	17.820	0.35	51.65	16.49	0.33	0.01
	Sec. 2	19.030	8.530	0.19	26.43	8.45	0.17	0.01
	Sec. 3	**29.500**	**22.450**	**0.94**	**116.78**	**37.38**	**0.69**	**0.03**
	Sec. 4	57.720	16.350	0.81	101.44	32.48	0.59	0.02
	Sec. 5	65.360	10.647	0.81	88.27	28.31	0.46	0.02
	Sec. 6	81.250	21.235	0.66	82.53	26.42	0.50	0.02
	Sec. 7	115.350	16.065	0.11	12.11	3.88	0.06	0.00
	Sec. 8	118.300	23.510	0.10	11.33	3.63	0.06	0.06

For the first scenario, for the same road, NR 28, the atmospheric pollution due to the traffic has been determined, taken into consideration the pavement condition assessed previously. For the second scenario, after applying different intervention strategies, the road has been considered having an optimum pavement condition, thus the atmospheric pollution is influenced, in this specific instance, only by traffic. As well with the first scenario, the analysis for the assessment of the ecological impact associated with of ideal scenario hypothesis has been also performed using COPERT 4 software. The results envisaged are presented in Table 4, which presents the summary results obtained from traffic modelling necessary to quantify the pollutant emissions produced by road traffic on NR 28.

Table 4
Quantitative Evaluation of Pollutant Emissions on National Road NR 28 from Iaşi County with COPERT Computer Software (Condurat *et al*., 2016)

National road	Sector	Kilometric position	Sector length km	CO t	CO_2 t	FC t	NO_x t	PM t
DN 28	Sec. 1	7.100	17.820	0.27	38.21	12.20	0.25	0.01
	Sec. 2	19.030	8.530	0.14	19.50	6.23	0.13	0.00
	Sec. 3	**29.500**	**22.450**	**0.69**	**87**	**27.84**	**0.52**	**0.02**
	Sec. 4	57.720	16.350	0.59	72.68	23.27	0.42	0.02
	Sec. 5	65.360	10.647	0.6	63.02	20.21	0.33	0.01
	Sec. 6	81.250	21.235	0.47	50.99	16.35	0.28	0.01
	Sec. 7	115.350	16.065	0.09	9.10	2.92	0.05	0.00
	Sec. 8	118.300	23.510	0.08	8.91	2.85	0.05	0.00

An important aspect is that in the hypothesis of the rolling stock configuration remaining mostly the same, the level of pollution will significantly increase. Therefore, a major upgrade of the fleet configuration and an intensive promotion of ecological modes of transportation are required in order to comply with the European reduction targets for greenhouse emissions, as part of Kyoto Protocol. On the other side, from a comparative perspective, another significant aspect for decreasing the carbon footprint associated with the road traffic is represented by pavement condition, driving behavior and speed circulation.

As it can be seen in Table 3, in the hypothesis of an ideal pavement condition, the total emissions are decreased by 10.21% as compared to the previous case. For a rapid and safe transition towards low carbon mobility a significant reduction and radical changes of the vehicle fleet configuration is necessary, which will result in a more sustainable future and a clean society. This scenario has the purpose of underlining the significance of applying intervention strategies for periodical road pavement maintenance and rehabilitation in order to advance towards a zero-carbon society. In order to reach this significant target, a vast set of action must be undertaken for each component of the transport system, namely the rolling stock, road infrastructure and management system.

4. Technical Recommendations for Reducing the Critical Level of Ecological Impact

The most significant methods for reducing the environmental impact associated the transport system are presented below.

4.1. Recommendations for Reducing the Impact of the Road Infrastructure

All types of impacts can be prevented and mitigated using methods and measures specific to each type of impact. Thus, for the prevention of soil erosion in the initial phase and the execution of the road project, certain specific measures should be taken to avoid the execution of borrow pit with slopes higher than the slope of the natural terrain, minimize the areas to be grubbed up and cleaned by the vegetation, replanting the area immediately after the operations, avoiding construction in sensitive areas (steep hills) and in already contaminated land. Also, the erosion phenomenon can be prevented by protecting the slopes, performing the interceptor drains, supporting walls or reinforcing the earth with geotextile materials in order to ensure stability of the slopes (Hoban *et al*., 1997). Recommended prevention methods to protect the quality of water sources consist of the use of uncontaminated materials, the minimization of the number of passes over the watercourses and the avoidance of the construction of the routes in areas susceptible to erosion. Reduction of the effects of water pollution can also be achieved by continuous monitoring of drainage flows, through the execution of decanting basins, bottom sills, interceptor drains and treatment of already polluted water.

4.2. Recommendations for Reducing the Impact of the Rolling Stock

As a response to the issues specified above, specific prevention, mitigation and compensation measures must be developed and implemented shortly. The new emerging technologies, in order to reduce the carbon dioxide emissions, refer mostly to carbon efficient cars, which use alternative sources of fuels, plug-in hybrid cars, electric cars, fuel cell cars and flex-fuel vehicles.

The new low carbon mobility configuration of the vehicles fleet implies fuel efficiency by usage of improved vehicle structures and engines, but mostly alternative fuels. The features related to improvement of fuel efficiency refer to reduction of CO_2, NO_x and particulate matter emissions. Nowadays, these objectives might be successfully accomplished due to progress in vehicle design. This way, enhancing fuel efficiency can be achieved by improvements brought to aerodynamic characteristics, reduction of vehicles total weight and usage of high performance engines. Improving the vehicles characteristics aims a significant decrease in atmospheric pollutants, mainly of CO_2 emissions. The development of new polymers, composite materials and so-called "memory metals" which are more resilient and lighter as compared with conventional materials should also lead to significant reductions in quantities of burned fuel (Budd, 2013; Condurat *et al*., 2016).

Mitigation of negative impacts derived from motor vehicles also can be achieved boosting chemical energy conversion efficiency of the fuel into mechanical energy required to start up and move the vehicle by increasing the thermodynamic efficiency, reducing friction forces inside the engine, improving the transmission of the vehicle and installing smaller tanks and photovoltaic panels to power cooling system (Kahn *et al*., 2007; The UK Government's Business Taskforce on Sustainable Consumption and Production, 2008). The use of alternative fuels like liquid hydrogen (H2), biofuels, synthetic fuels and liquefied natural gas (LNG), as alternative energy sources (fuel cells) leads to a significant reduced quantity of pollutant emissions released into the atmosphere (Litman, 2015).In the context of significant changes in transportation policies and technology, the way for improving the sustainability of a city or region consists in the construction and integration, in the existing road network, of cycling infrastructure, as the first step in promoting modal shift from car to bicycle with significant benefits on environment and social sectors. Also, the decarbonization of urban public transport can be achieved through a smart use of resources, emphasize on public transport (electric buses), rail transport and use of eco-efficient vehicles. The context of providing better operating condition for buses, for example an increase of 5 km/h of commercial speed on a bus, leads to a reduction with 20% of the consumption and thus of GHS emissions (International Association of Public Transport, 2012). Prevention and mitigation of traffic pollution can be achieved by taking measures as traffic diversion in urban areas or placing junctions and crossings at a significant distance from residential areas. Other sustainable measures for CO_2 emissions reduction refer to: decrease in traffic congestion by increasing road capacities, planting trees on the side of the road, creating appropriate road geometry, pedestrian areas in dense and compact areas with a wide diversity of services and encouragement of the use of public transport, walking and cycling (Patterson, 2014). In order to customize the analysis accordingly to sustainability principles, the specific measures mentioned above have been considered for the development of several case studies on traffic scenarios regarding a new fleet composition. The effects of pollution caused by the movement of transport means are felt over an extended area, contributing to a number of factors, the most significant being atmospheric, topographic and climatic conditions, traffic congestion, type of fuel used, vehicle age, and inadequate maintenance These effects result from the exhaust gases discharged into the atmosphere (chemical pollution), through the spillage of the running surface, the dust and the noise produced by the vehicles, as well as accidental spillage of toxic chemicals in the event of accidents. CO_2 emissions, fragmentation of ecosystems and the elimination of PM10 particulate matter in the atmosphere are currently considered the most pressing issues facing mankind. The next place is occupied by the waterproofing of the soil as a result of the permanent covering of the surface with an artificial waterproof material for building and road construction, noise pollution, NO_x emissions and ozone levels (Borken, 2003). Exhaust gases In addition to affecting air quality, population health and ecosystem balance; it also contributes to the increase of global warming. By burning fossil fuels in engines, the mechanical energy required to start and drive vehicles is produced, but also gas mixtures and harmful particles removed through the exhaust gases. Next, a brief presentation of the most significant toxic gases derived from the circulation of road vehicles will be presented. Methods of preventing and mitigating impacts from means of transport consist of improving vehicle production and maintenance techniques by using the so-called "hybrid" and "flex fuel" vehicles, where fossil fuels are replaced with biofuels, respectively with a mixture Gasoline and ethanol as well as the development of public transport and non-motorized means of transport. The mitigation of the negative effects of motor traffic can also be achieved by modifying their characteristics (Kahn *et al.*, 2007) Improving the aerodynamic characteristics and increasing the efficiency of the chemical transformation of the fuel in the mechanical energy needed to start and run the vehicle by increasing the thermodynamic efficiency, reducing the frictional forces inside the engine, improving the transmission, Alternative fuels and avoiding the use of old vehicles. Preventing and mitigating the effects of traffic-based pollution can also be achieved by taking measures to divert traffic from urban areas or by placing intersections and passages at a significant distance from residential areas. Also, reducing traffic congestion by providing increased road traffic, building drainage paths along transport routes, and adopting appropriate road geometry elements can make a significant contribution to preventing and mitigating negative impacts.

4.3. Recommendations for Reducing the Impact of the Management System

Road system management allows the optimization of transport system performance and the continuous improvement of infrastructure in order to increase traffic safety. The management of the transport network refers to planning, programming and realization of all the processes necessary to preserve the integrity of the infrastructures, as well as the environment (Andrei, 2003). The management system can be applied both in the technical project phase and in the transport infrastructure phase. In the initial phase of the project, in addition to technical and economic planning, the environmental issues that the location of the infrastructure will create in the area will be taken into account. Economic planning refers to the cost–benefit analyzes of the alternatives, their comparison, and ultimately, the choice of the optimal solution. In the phase of the exploitation of the infrastructures, through a modern management system, the prioritization and optimization of the maintenance works, rehabilitation, modernization or reconstruction. This prioritization is based on a complex process of analyzing the existing situation, the timing of the structure and the state of distress. The existence of a well-structured management system allows good management and management of transport networks in order to increase the overall performance, predicting the costs necessary to develop and maintain them, as well as identifying and investigating environmental issues such as soil, water, air, soil erosion, habitat fragmentation, landscape degradation, etc. The current trend in traffic management is represented by the notion of "smart infrastructure" and "intelligent systems". The use of "smart" technologies and systems will allow for reducing travel time, remote monitoring of traffic, and the prevention and mitigation of climate change.

4. Conclusions

The main objective related with this paper consist in the definition of various classes of impact and in the development of specific technical recommendations for the use of these classes of impact for evaluation of actual ecological status of the road transport system including all its components (fixed plant infrastructure, rolling stock and its management scheme) given in order to reduce this negative impact. These environmental impact classes can be a useful tool in decision-making, helping the manager decision-makers to prioritize rehabilitation work. Impact classes can also be used to identify critical areas for urgent implementation of intervention strategies to mitigate and compensate the produced negative effects. The case studies have been performed on the national road NR 28. In order to evaluate the ecological status of the national road NR 28 the pavement condition of the road section has been determined based on the PCI numerical indicator, within the first case study. Further, based on the results obtained from the pavement condition assessment through visual investigations each road section has been classified from an environmental point of view using the impact classes. Considering that E1 road sample shows the highest distresses with a degree of severity pointing to a very bad pavement condition, the road is considered as impracticable, which means that from an ecological point of view is ranked in the Critical Impact Class. These environmental impact classes, corroborated with the traffic safety and comfort criteria, transposed by the signs of distress, evenness, roughness and bearing capacity, testify to the need to apply specific rehabilitation strategies for the analyzed sector. The second case study emphasises the significant increase of the greenhouse gas effect and also fuel consumption due to the traffic flow. Based on the results obtained, specific strategies, required for an improvement of road network sustainability have been presented. This case study focusses on two scenarios. For the first scenario, the ecological impact associated with the road traffic has been determined based on the actual road network pavement condition, presented previously. The second one is the ideal situation regarded from traffic sustainability perspective, when the road pavement has been properly rehabilitated, at an optimum moment. In this scenario the vehicles speed does not depend on the pavement condition and thus the road service level is free flow. An important aspect is that in the hypothesis of the rolling stock configuration remaining mostly the same, the level of pollution will significantly increase. Therefore, a major upgrade of the fleet configuration and an intensive promotion of ecological modes of transportation are required in order to comply with the European reduction targets for greenhouse emissions, as part of Kyoto Protocol. On the other side, from a comparative perspective, another significant aspect for decreasing the carbon footprint associated with the road traffic is represented by pavement condition, driving behaviour and speed circulation. In the hypothesis of an ideal pavement condition, the total emissions are decreased by 10.21% as compared to the previous case. For a rapid and safe transition towards low carbon mobility a significant reduction and radical changes of the vehicle fleet configuration is necessary, which will result in a more sustainable future and a clean society. Finally, the paper presents the most significant methods for reducing the environmental impact associated the transport system.

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EVALUAREA IMPACTULUI ECOLOGIC AL STĂRII THNICE A DRUMURILOR ŞI A INTENSITĂŢII FLUXULUI TRAFICULUI RUTIER (II)

Abordare practică – Studii de caz şi recomandări tehnice

(Rezumat)

În prima parte a lucrării după descrierea principalilor indicatori de mediu şi a diferitelor lanţuri de cauzalitate luate în considerare pentru evaluarea impactului ecologic negativ al drumurilor, se prezintă influenţa stării tehnice asupra mediului înconjurător pe baza degradărilor din structura rutieră, rugozităţii stratului de rulare, precum şi pe baza intensităţii traficului rutier. Pe baza cercetării teoretice efectuate în prima parte, în cea de-a doua parte a lucrării au fost concepute şi propuse clase de impact ecologic specifice în vederea utilizării ulterioare a acestora în practică pentru evaluarea stării ecologice reale asociată sistemului de transport rutier. În cele din urmă, sunt prezentate recomandări tehnice pentru reducerea efectivă a impactului ecologic, pe baza rezultatelor studiilor de caz semnificative realizate pe drumul național DN 28.