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TRANSPORTATION OF DANGEROUS GOODS IN THE CROATIAN TRAFFIC SYSTEM

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ABSTRACT

The transportation of dangerous goods in the transport system is an especially interesting area of expert and scientific interest, because of the transport security and the possible harmful consequences after the emergence of transport accidents. The transport system development is being examined from the aspect of sustainable development and the influence of transport on the environment, the structure of dangerous substrates and transport system accidents with that kind of freight. Also, an example of the account of underground water reserves and road infrastructure of Croatia is being given. This work serves a goal of pointing out to the significant quantity of dangerous transport substrate that is being daily transported in the transport system, the possible consequences from the aspect of sustainable development and environment protection, and to the need for application of higher safety and protection standards in that field.

1 INTRODUCTION

The fundamental documents of environment management on the state level are: National Environmental Strategy, Transport Development Strategy and National Environmental Action Plan. The Strategy refers to the coordination and guidance of environmental development and long term goals of that development in coordination with the general economic, social and cultural development, and the Plan serves to ratify the measures and activities for its conduction.


Transportation of dangerous transport substrate is a question of major importance for the functioning and development of the transport system, not only concerning the transport safety, but also concerning the principles of sustainable development and environmental protection. Dangerous goods are, by definition, substances, mixtures or preparations which depending on their composition, quantity and concentration can in the case of a transport accident or unprofessional management jeopardize the health or life of people by pollution of the soil and land cover, waters (rivers, underground aquifers, lakes and seas) and the atmosphere, and
can cause destruction of woods, acid rain and similar phenomena. Important elements of the transportation process of dangerous goods are especially vital in its preparation, which refers to the possession of the corresponding legal documentation (transport documents and documents concerning the particular safety measures during the transportation), professionally equipped crew, and also technical validity and equipment of the vehicle.

2 SUBSTAINABLE DEVELOPMENT OF THE TRANSPORT SYSTEM

The important aspect of the sustainable development of the transport system is protection and quality improvement of the natural resources: soil, water, mineral materials, air, climate, plant and animal life.

One of the most relevant goals which must be specially emphasized is also the protection of underground aquifer of drinking water.

The example of Zagreb can be mentioned where, in hydrological sense, of major importance are the concentrated waters of the River Sava and its runoffs, and because of the significant well fields of underground water. Large natural entities - Medvednica, its forests, Sava's alluvial plain and Vukomerička gorice are an existential ecological framework of Zagreb.

![Diagram: influence of transport on the environment](https://via.placeholder.com/150)

**Figure 1:** Influence of transport on the environment (Source: Hensher D. A., Button K.: Handbook of transport systems and traffic control, University of Sidney, George Mason University, Elsevier Science Ltd, Oxford, 2001., pp.287)

The following goals of the National Transport Development Strategy can be extracted, which particularly refer to the sustainable development of the transport system:

1) the goals that refer to the general development of Croatia and its international affiliation (the optimal exploitation of the resources, equivalence of general and individual development interests, equivalence of transport subsystems and equivalence of such development with the principles of the sustainable development)

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4 Strategija prometnog razvitka Republike Hrvatske, NN br. 139/99
2) the goals of coherent and gradual transport development and its subsystems also (reaching the level of development of transport branches compatible to the European standards) 
3) the goals of transport development that refer to the transport safety (to ensure the higher level of transport safety by building alternative transport connections, which can take over the function of main transport lines during traffic jams), when it is essential, according to the previous goal to ensure quality of the regional and local communication 
4) equivalence of the transport development goals and the environment protection, raising the level of attractiveness of public transport, and to reinforce the involvement of rail which has been given priority in relation to other transport subsystems, viewed from the aspect of environment protection. 

According to the ECMT strategy and the common transport politics of the EU the main goals of the complementary transport politics are:

- targeted planning and management of the transport courses 
- environment protection 
- increase of the transport safety 
- increase of the efficiency of the transport system 
- compensation of the consequences of market deregulation and liberalization in the transport sector. 

The sustainable transport is a part of the global idea of sustainable development on the planet, which was promoted in 1922 at Rio de Janeiro Earth convention, where the action plan by the name of AGENDA 21 was adopted. 

The plan declares that (Agenda 21 and other conventions from Rio) «transport uses approximately 30% of the world commercial energy production, and spends around 60% of the world’s oil production. The sustainable development is a global development which appreciates the need to protect natural resources. 

3 THE STRUCTURE OF DANGEROUS TRANSPORT SUPSTRATE AND ACCIDENTS IN THE CROATIAN TRANSPORT SYSTEM 

In the following pages of this work a short account of the structure of transported dangerous supstrate is given, in the period of one year within the national transport system. 

The most transport accidents in the dangerous goods transportation, that result with the environment damage, occur in the road transport subsystem. 

During the period from 1999 to 2000 around 72% of the accidents in the dangerous goods transport have been caused by the drivers' inattention, where 62% happened due to the unadjusted speed with the road conditions. With these accidents there is also a problem of fluid and gas transfusion from the overturned vehicles (improper connections or possession of improper transfusion pumps), deficient number of adequate cisterns, and absence of jacks with a driver. 

8 Ibidem 
According to the possible harmful consequences of the dangerous goods transportation the high demands concerning road routes seem logical (horizontal and vertical curves, condition of the pavement and other technical elements of transport significant for the transport safety). It can be concluded that it is essential to make a right choice of itinerary of dangerous goods transportation in national and international transport. The need to organize the dangerous goods transportation as much as possible by orientation to highways and main state roads is obvious from the above.\textsuperscript{13}

Significant characteristic of dangerous goods transportation is a multidisciplinarity, which consists of knowing the properties of dangerous substances, ways of transport, accident treatment and damage elimination, professional qualifications of staff (for preparation, manipulation, transport), equipment of vehicles, regular marking of dangerous substances and vehicles.\textsuperscript{14}

After analysing the dangerous goods transportation according to typ of transported substances during 2001 for example it is possible to declare relative structure according to separate transport subsystems:

- rail transport - 65\% out of the total dangerous transport supstrate are flammable fluids, 13\% are gases, 8\% are inflammables and 3\% are poisonous substances.
- road transport - 80\% flammable fluids, 11\% gases
- pipeline transport - 74\% flammable fluids, 26\% gases
- sea transport - 97\% flammable fluids, 2\% gases.\textsuperscript{15}

In that year the average daily transport in Croatian transport system (rail, roads, pipeline and sea ports) carries out around 59 thousand tonnes of dangerous goods, respectively:

- 49 thousand tonnes of flammable fluids
- 8 thousand tonnes of gases
- 207 tonnes of poisonous substances
- 43 tonnes of explosive materials and
- 2 thousand tonnes of other dangerous substances.\textsuperscript{16
Figure 2: Account of the underground water reserves and road infrastructure in Croatia (Source: National Environmental Action Plan, NN 50/99)
<table>
<thead>
<tr>
<th>Type of dangerous goods</th>
<th>Rail</th>
<th>Road</th>
<th>Pipeline</th>
<th>Sea</th>
<th>River</th>
<th>Total</th>
<th>REL. STR. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosive materials</td>
<td>2</td>
<td>9</td>
<td>0</td>
<td>2</td>
<td>0.0</td>
<td>13</td>
<td>0.1</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>15.4</td>
<td>69.2</td>
<td>0.0</td>
<td>15.4</td>
<td>0.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Gases under pressure, fluid and without press.</td>
<td>403</td>
<td>340</td>
<td>2151</td>
<td>106</td>
<td>0.0</td>
<td>3000</td>
<td>12.4</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>13.4</td>
<td>11.3</td>
<td>71.7</td>
<td>3.5</td>
<td>0.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Flammable fluids</td>
<td>1610</td>
<td>3033</td>
<td>6687</td>
<td>8832</td>
<td>222</td>
<td>20384</td>
<td>84.6</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>7.9</td>
<td>14.9</td>
<td>32.8</td>
<td>43.3</td>
<td>1.1</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Corrosive materials</td>
<td>47</td>
<td>17</td>
<td>0</td>
<td>6</td>
<td>0.0</td>
<td>70</td>
<td>0.3</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>67.1</td>
<td>24.3</td>
<td>0.0</td>
<td>8.6</td>
<td>0.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Flammable solid materials</td>
<td>157</td>
<td>5</td>
<td>0</td>
<td>38</td>
<td>0.0</td>
<td>200</td>
<td>0.8</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>78.5</td>
<td>2.5</td>
<td>0.0</td>
<td>19.0</td>
<td>0.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Poisonous substances</td>
<td>58</td>
<td>22</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>84</td>
<td>0.3</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>69.0</td>
<td>26.2</td>
<td>0.0</td>
<td>1.2</td>
<td>3.6</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Infectious materials</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>37</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
<td>55</td>
<td>0.2</td>
</tr>
<tr>
<td>Oxidizing materials</td>
<td>67.3</td>
<td>22.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>19</td>
<td>126</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>146</td>
<td>0.6</td>
</tr>
<tr>
<td>Miscellaneous dangerous materials and items</td>
<td>13.0</td>
<td>86.3</td>
<td>0.0</td>
<td>0.7</td>
<td>0.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total of dangerous goods</td>
<td>2423</td>
<td>3627</td>
<td>8838</td>
<td>8990</td>
<td>222</td>
<td>24100</td>
<td>100.0</td>
</tr>
<tr>
<td>Relative structure in %</td>
<td>10.1</td>
<td>15.0</td>
<td>36.7</td>
<td>37.3</td>
<td>0.9</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

After analysing the data shown in Table 1 it can be concluded that the most represented structure out of the total dangerous transportation supstrates are:

- flammable fluids 84.6%
- gases under pressure, fluid and without pressure 12.4%

which makes 97% of the total transported dangerous goods in the Croatian traffic system.

Concerning the delicacy of transport safety, possible risks and the increasing traffic density, the road transport subsystem, within which 14.9% of total quantity of flammable fluids and 11.3% gases under pressure and fluid gases is transported, is of a special interest.

A significant fact is also that 69% of explosive materials is being transported in the road transport subsystem.

From the basic postulates and goals of preserving the environmental stability and valuable parts of the environment this work is about to emphasize the following:

- "the right for development is achieved in a way that the needs of development and the environment, of present and future generations, are equally satisfied",
- "the environment protection is an integral part of the development process and cannot be examined when isolated".

4 CONCLUSION

The development of the transport system must necessarily be carried out on the basis of scientific and expert conceptions of the processes that take place within it. The goals must be realized on the principles of sustainable development which by satisfying the needs of present generations does not jeopardize the right and the possibility of the next generations to achieve those for themselves. The transport development must take place according to the principle of generations' use and protection of the natural resources, and preservation of the healthy human environment.

During time it comes to the more and more frequent use of dangerous materials and their transportation in the transport system. In the cases of transport accidents considerable consequences in the sense of the environment pollution are possible. In the prevention of these accidents and elimination of their consequences a change of relationship towards the natural resources (drinking water, valuable natural entities, agricultural and wood areas etc.) is imperative and becomes one of the basic postulates of the transport development.

REFERENCES

6. Mataš A.: Ekološke nesreće u Republici Hrvatskoj kao popsljedica prijevoza opasnih
14. Program prostornog uređenja Republike Hrvatske NN br. 50/99.