Pipeline Transportation of Goods

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The article includes the concept of the "underground transport of materials in Europe". Europe is a very densely populated area and there are more and more such areas where people find jobs and better living conditions meeting their needs. Densely populated area requires a large amount of materials, energy, food, water, etc., which must be transported to these areas on a daily basis. Conversely, all the waste and the products of the activities of these areas must be transferred to other places. This gives rise to high demands for transport, the quantity of the transported material and the transport speed. This also results in creating a large space for storage, transshipment, railway stations, airports, etc. The only way to solve this traffic problem of the future is, according to the authors, the underground transport of materials between the densely populated areas. The solution to this problem is outlined in almost the whole extent of the problem from the choice of transport routes to organizing their operation. The aim of this project is to transport goods and materials; in no case do we discuss transport of people.

Keywords: Pipeline transport of goods, pipeline transport, permanent development of transport, protection of nature.

1. INTRODUCTION

Europe is a very densely populated area and there are more and more such areas where people find jobs and better living conditions meeting their needs. Densely populated areas require a large amount of materials, energy, food, water, etc., which must be transported to these areas on a daily basis. Conversely, all the waste and products and activities of these areas must be transferred to other places. This gives rise to high demands in transport, the quantity of transported material and the transport speed. This also results in creating a large space for storage, transshipment, railway stations, airports, etc. Such a solution is not suitable for transport of materials in such directions as Asia and even some parts of Europe because there are large unpopulated areas, or areas unsuitable for agriculture or productive forestry. Rail transport is clearly more suitable for such areas. One of the suitable options for addressing the traffic problem of the future is, according to the authors, the underground transport of material between the densely populated areas. The authors believe it is even the only possibility of developing the transport system; the later we begin to deal with the problem, the more damage will be caused by humans to the nature in such areas.

The solution is to create a link between the areas by underground tunnels which will enable moving containers full of goods, products, materials, etc. in relatively high speed. It should be emphasized that the intent of this project is just and only material, because it needs no specially suited climatic conditions, it can bear high acceleration and breaking, and does not need to stabilize the position as it would be with the transportation of people.

They want comfortable and pleasant conditions for travelling and quality of passenger transportation will absolutely continue growing. Should people get stuck among trucks on congested roads? Should they avoid travelling by air due to extreme density of air cargo traffic because aircraft accident rate will unavoidably increase? Shall they resort to a comfortable and pleasant water transport, however slow it is?

There are only a few, but very important questions, which we must seek an answer to.

Let us look at it this way. The intensity of **car traffic** is rapidly approaching its maximum

capacity. Highways are congested now. Shall we widen them? Shall we increase the number of lanes and thus increase the number of accidents, which will certainly grow with the increased overtaking? What is more, there are tunnels through the mountains, that may not be extended. We would have to bore another tunnel, otherwise it would become another bottleneck setting the maximum limit of the traffic artery. To finally assess the situation in road transport, we can almost definitely say that the fulfillment of transmission capacity is very close and that further improvement would require great expenses and would cause extensive inconvenience to people. **The only option is a transfer, or a gradual transfer, of road transport of materials off-roads.**

Increase in the transport of materials by **air transport** is possible, but fortunately for humans, it has its limits. The first one is the capacity of airports. Technical support to an airport is also increasingly space-consuming. The second one is the noise which will probably decrease in the future to the feasible limits, however the fuel consumption will increase respectively. Another danger is releasing the emissions in high altitudes, where the plants cannot help reducing CO2. Yet people do not want to perceive the harm they cause, as they like to use aircrafts to transport over long distances. Let's leave this transport for people, but do not increase unnecessarily air freight transportation.

Increase in the transport of materials by **water transport** is indeed possible and it has been increasing. It is therefore an important measure to preserve the possibility of developing the transport of materials, but it has its limitations, too.

Increase in the transport of materials by rail is a sensible way. We all know that **rail transport** is less flexible than road transport because it is not possible to transport materials to the ultimate customer. Whatever the case, there exists an opportunity to increase the capacity of the rail freight transport, but it does not provide the final solution.

2. PIPELINE TRANSPORTATION OF MATERIALS

The authors take a view that there is only one way to increase transmission capacity and it is the pipeline transportation of materials, emphasizing materials, not people. The reasoning is based on the fact that if we can transport large quantities of oil, gas and water through pipes at distances of thousands kilometers, so why not to pipe material? Here are some examples of previously realized and sometimes successful attempts.

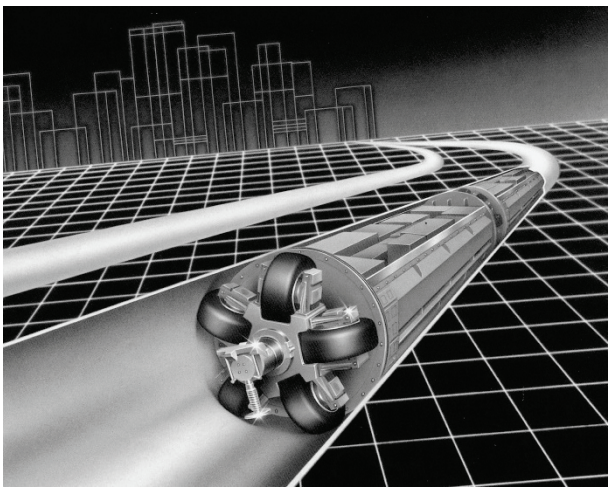

Fig. 1. Decorative figure of Pipeline Transportation of limestone in Japan from SUMITOMO METALS company.

Pipeline transport in Japan.

A good example and demonstration of future pipeline transport is the underground transport company SUMITOMO METALS in Japan. It is the transport of limestone that is carried over a distance of 35 km and is it a demonstration of an environmentally friendly transport of materials. The project of underground transport realized is called "Capsule Liner," which loosely translated can be called container transport. It is a revolutionary system of transporting materials. As evident from the figures containers with bantam wheels that lead container in the pipeline are used. The container moves relatively freely through the pipe, driven by a relatively low air pressure; the driving force is achieved by a fan. To increase the capacity, containers are connected in threes creating a "container train".

Throughout the container route the train is monitored by computer and all traffic is fully automated from the point of command to leave to the final destination. The transport is safe and independent of the weather. This system is considered the transport mode of the future by the designers, the authors must agree. In the future it will significantly limit the movement of trucks and trains on the ground.

Underground material transport has really significant advantages:

- the most important advantage is that it does not affect the movement of humans on the

surface
- it is clean and safe and environmentally friendly indeed,
- it practically replaces continuous transport,
- it creates the opportunity to haul various types of materials,
- it is completely independent of the weather and operation of other modes,
- according to the experience in Japan it requires relatively low maintenance
- operation costs are very low (investment costs are relatively high).

Figure 2 is a map of Europe showing how people will be deployed in Europe in the middle of the millennium. The source is an earlier study and the author has found no original authors, and therefore cannot rely on them. This section is about the size of 2000 x 2000 km.

As we can see on the map, there is a large concentration of population around the main transport routes. These are mainly due to geographical conditions, such as mountains. People are very likely to settle around major rivers. Taking that in account we can very well estimate what the transport routes will be. After very careful consideration we can also discern how much material will be moved along these populated corridors. This, according to the authors, clearly shows the need for transportation of materials to be moved below the surface on which people will live.

Let us now list several critical issues that will be addressed in the near future.

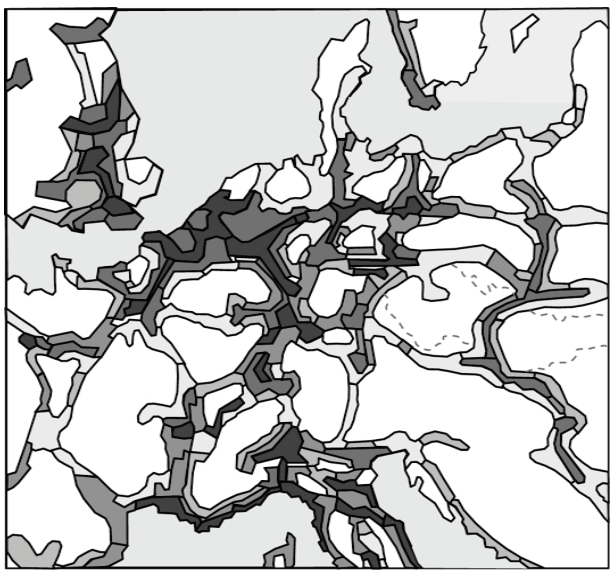

Fig. 2. The density of population of Europe in the year about 2500th. Adapted by the author of an earlier study.

2.1. TRANSPORT SPEED

Along these indirectly designated routes will move a great variety of different materials that people need for their comfortable lives. Isn't it an appealing idea that some or even a large part of the materials would be moved without us knowing it at all? That people will move in cars and trains on routes with a minimal number of trucks and freight trains? It will not be possible to do without trucks completely, but there could be only as few as absolutely inevitable. The part of the map of Europe is in the dimensions of about 2 x 2,000 km from the center, so the route from Italy to Sweden or to the north of England is really almost 2,000 km. A truck with an average speed of 60 km per hour on this route will travel about 35 hours and a train with an average speed of 80 km per hour on this route will take 25 hours under optimal conditions. If the container travels with the speed of 150 km per hour, the distance will take 14 hours. These are only approximate journey times because we have neglected all handling times. These would be the shortest for trucks and longest for trains, so the total journey time will be different and thus the comparison of transport speed will be slightly different.

2.2. THE CAPACITY OF TRANSPORT VEHICLES

So far we have neglected in this consideration the important fact of the capacity of the transport vehicle. While a truck with a trailer can carry a load of approx. 20 tons, the train can carry a load of total mass 1,000 tons. A train can therefore replace 50 trucks with trailers. It is a big difference, however even this is not a reliable indicator of the importance of these means of transport, because the truck will reach the ultimate customer or a logistics center. Rail freight terminal, as this implies, would have to serve at least 50 trucks on both sides. So in this simple reasoning we cannot fully compare the advantages and disadvantages of both modes of transport.

2.3. THE ENERGY REQUIRED TO TRANSPORT

Let us return to container transport via pipelines. Consider the diameter pipelines 1.5 meters, which is already the gas sometimes used. If the length of the container 4 m so its volume is 28 m^3. If for example, filled with vegetables, its weight can be approximately 15 tons while the

transport of coal would be around the weight of 30 t. In this case it virtually replaces the transport trucks. If the velocity of the container is an optimistic 40 m per second, and the distance between moving containers was 400 meters, then the mass of 1,000 t was carrying 33 containers, which filled the long stretch of 13.2 km and at speeds around 150 km/h would be time to remove the container terminal in the target 20 seconds.

An interesting question is driven container. This possibility is tested in Japan drive air, a fan. It's a drive-known and tested by tube post, which is used for many years. Just for information, it is a pipe in the Prague Post, but outside it is also used in large post offices and supermarkets. The second option is the use of linear motors, as is now increasingly extends to drive trains, known as Maglev. The big advantage of such a tail would be to achieve high velocity and up to 300 km/hr.

Great speed, however, gives little time in the terminal to remove the container from the transport route.

2.4. ARCHES TRANSPORT ROUTES

Topology of transport routes is another question that must be resolved gradually. The choice of routes depends on the radius length of a container or container sets attached to the train. The radius of the transport route also depends on how you create traffic routes.

Pipelines for transporting materials are likely to be composed of steel pipes like pipes for transportation of oil, gas or water This is not the only option and it cannot be said yet whether it is the only sensible option. A container, when moving inside the pipeline, will probably float on a cushion of air, air layer created by the air around the pipe wall, which will theoretically have a very low rate compared to fast a moving container. One cannot exclude that the container, in some places, may wipe the walls. This would lead to wear of the walls and therefore to the occasional replacement of pipes. We consciously use the term occasionally, because it is one of the important factors, and it is crucial to consider it to prevent the costs of maintenance of transport routes.

The second option is the creation of concrete pipe sections. In this case there is a thought, if there ever is a "pipeline" of circular cross section. What benefits should profiles with square or rectangular cross-section bring? At first glance, it offers the idea that a square profile can have its advantages in terms of container management. When considering the already four-sided section, so why should not be multi-shift sections, such as six-sided and there is another problem to solve.

2.5. WAY TO CREATE A TRANSPORT ROUTE

The Infrastructure section decides how to create a transport route. Is it because it would be about the whole project is expensive. It offers several options. It is most common in the trench excavation and pipe of circular cross section. If we store the pipe into the trench, as shown in Figure 3, the profile "pipe" is acceptable.

Another possibility is the creation of transport routes stamping, i.e. create a "tunnel" in mining and in tunnel pipe store. Create a tunnel with mining method is, given the size of its cross section, stamping for circular tunnel drilling machines. This is how a common stamping technology works. The diameter of e.g. 1.2 m is in principle not a big problem in this case, but a circular cross section is subject to the minimum cost.

Thus, if we assume a circular cross section, thus offering the possibility of progressive tunnel and it is quality concrete pipe extrusion. This means that the earth's surface would be minimally disturbed.

Fig. 3. 1,100 km long pipeline with a diameter of 4 m for transport of water across the desert in Libya.
Source: J. Kotulič Bunta.

3. HOW TO APPROACH THIS PROBLEM

The problem of sustainable transport development, particularly in densely populated areas relating to transport in a large population area, in my opinion, was Europe and especially Central Europe. We need to solve this problem just in this area. Thanks to the organization of the European Union, it is very useful to start this

project as soon as possible. Our idea is that from each participating country selected 2 to 3 major professional personnel suitable composition! This success is the most important solutions. This team will deal with individual problems of the project.
Costs on the work of such workers with good, if not excellent, creative abilities in the first two to three years will not be great. Only then, according to results of work again to evaluate the next steps, but at that time it will be appropriate if not necessary to start with the development of individual elements that are the building blocks of the project. Of course I assume that the project holder, the Czech Republic, but it depends on where it appears the right person to lead such a team.
To start such a project prepared by a group of Czech experts request for financial support of the project this would be the basis for the initiation of this creative work**.**

4. BENEFITS OF THIS PROJECT

The benefit of this project is not only that it will prepare only one way to ensure sustainable transport development. Solving the economic way of creating underground transport routes, especially without affecting the surface of objects is the possibility of tunneling underground section of smaller cities. That is a possibility of significant improvement mini collector storage and maintenance of utility networks in cities.

5. CONCLUSIONS

Finally, we would again like to point out that the capacity of current transport corridors and transport is approaching its maximum capacity fast. Traffic demands are growing rapidly. These two contradictory facts will project themselves relatively soon in the form of transport collapse. If we add the impact of transport on the environment both in terms of air pollution, noise, land use, water pollution and air pollution, we have to accept the opinion referred to in the introduction; that it is only possible and inevitable to have transport removed off the surface, namely underground. Underground material transport is practically the only possible solution for further development.

The solution to this problem must not be delayed any more. After 15 years we will return to this proposal again and urge the society to rapidly launch research and development activities in the areas that we outlined in this paper. Note that from a good idea to its realization often very long time passes and therefore lets look for good ideas and suggestions so that our next generation does not suffer because we have neglected all that was possible.

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Note: Design and considerations are the author's own work and therefore a minimum amount of foreign documents was used.

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