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**PROGRESSIVE TRANSPORT SYSTEMS**

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Katedra dopravního managementu, marketingu a logistiky

Specific transport systems were gradually developed in this country in the frame of logistical chains, starting with palletization and containerization to the current developing system of containerization and the supposed system of palletization in the future.

*Current and new progressive transportation systems are of a great importance in rationalization of flow processes by means of logistics.*

First of all, palletization and containerization enable qualitatively a higher form of carriage implementation, that is formation of so called transport chains, which is a specific way of innovation of current transport processes and following parts of goods flow.

The following effects of the new systems are especially expected:

- total increasing of carriage effectiveness;
- fuel consumption reduction;
- possibility of cost operations mechanization;
- favourable ecological impacts;
- use of unified transport units being able to haul by means of all transport branches (pallets, pallets, containers, superstructures);
- implementation of appropriate rational forms of work technology;
- maximum playing upon transshipment work mechanization;
- simplification of transport documents and making use of unified tariff specifications;
- assimilation of economical implements to the needs of integrated transport process;
- creation of conditions for rational work organization in the whole goods flow.

It is necessary to mention that the way how to ensure cohesion between public railway transport and enterprises *was searched in the classical railway transport as well*. This system is called *railway siding transport*.

Railway transport, with the aim to offer the carrier further possibilities, gradually introduced further new transport systems, whose aim is the *offer of more complex services*.

It concerns e.g. express carriage and piece-goods carriage as well, which is organized by nearly 90 railway stations in their districts through the Czech Railways network.

There is a system of stations with concentrated loading and unloading by the carrier at *the all-carriages consignments except the classical conveyance* where the customer must load and unload his consignment. The system has even its own technological process enabling concentration of loading and unloading work at the railway into the smaller number of railway stations and an advisable way of road service.

Systems of palletization and containerization are making best use of progressive transport and manipulation systems by then.

### 1. System of palletization

By virtue of material property analysis being transported in the Czech Republic, by virtue of work procedures, transport distances, economical effects etc., it was assigned that there are actually two main indicators which determine material availability or inaptitude for *transportation in pallets or containers as follows*:

1. material ability of palletization or containerization;
2. effectiveness of palletization or containerization introduction (comparison of expounded costs and profits).

Palletization can be presented as the first simple transport system, which is manipulating or in some cases storage system that makes full use of pallet for creation of complete transport ev. storage unit which then passes through material flow without any transshipment of own substrate from the manufacturer usually by means of a store to the consumer.

Pallets are constructed for manipulating by the forked device from under. They are usually quad-track, which enables manipulation from all four sides. It is possible to manipulate with them with the help of high-lift and low-lift trucks, fork devices at the tractors or loaders, ev. it is possible to manipulate with them by hanging on the crane upside or by the hydraulic hand, so far as this way is allowed by their constructions.

According to the Czech state norm, a pallet is featured as a device modified for stacking and forked manipulation in the Czech state norm.

*Basic devices* applicable for creation of appropriate manipulating unit are the following:

- pallets flat, post, box;
- rolltainers;
- sinus-trucks;
- pallecons.

*The advantages of palletization are especially:*

- fast location;
- fluent haul and clearing of a transfer;
- possibility of stacking;
- active aeration;
- saving of storage room;
- ensurance of transportation without losses;
- reduction of damages of all products during manipulation;

- enhancement of safety and hygiene of work;
- energy safety;
- operational costs safety.

*Classical pallets:*

A *flat pallet* is actually a manipulation support plate and serves for stocking of piece-goods, material in transport packing and bag material and fruit and vegetables in crates as well.

*Post pallets* are available for location of products and other materials which do not sustain or able direct stacking. They can be used at transport and storage with bag materials (seed for sowing and potatoes) and with fruit and vegetables in crates as well. Solid construction and possibility of removing goods from the stack allow making use of these pallets as an adjustable rack.

*Box pallets* are intended for location of materials either in transport packing or for transportation of materials in bulk. They can be all-wooden or all-metal or with a metal frame and wooden lining.

*Rolltainers* are rolling pallets, which enable a better manipulations and usage.

*Sinus - trucks* are pallets flat, post or box, furnished with a pair of built-in travel wheels, a pair of fixed legs and a bed for pin of an removable truck which having been removed makes possible for the truck to stand steadily. Their spreading out will not be great. We can expect their usage only in a storage, ev. workshop manipulation.

## 2. System of palletization

There is an effort to enlarge the assortment of offers how to transport specific kinds of goods in smaller transport, manipulation and storage units as well and that is why the enterprise KD - INTRANS started business relations with the Australian firm L.S.K. INDUSTRIES. That firm made an offer for deliveries and usage of completed technical, economical, storage, manipulation and transport system PALLECON, incumbent on usage of pallets and dismantling parts composed of two doors, two sides and a cover, which attached to a pallet creates a device as a stacking manipulating unit enabling the usage of device for mechanized manipulation.

The offered manipulation system PALLECON is intended for transportation of piece, loose and liquid materials, when the base of the system is created by a flat wooden quad-track pallet that has a dimension 1000 x 1200 mm for usage in Czech conditions. This type of a pallet came to use especially in England and in the whole western Europe as well. Next, there are negotiations of the firm L.S.K. Industries about starting mass application of this manipulation system in China, the USA. and Italy.

*The assortment of the Australian firm LSK's offer includes the following types of pallets depending on the way of their usage and the kind of transported goods:*

1. box pallets – CAGES,
  2. Pallecon – SECURITY,
  3. Pallecon – MINI BULK.
- add. 1 - *box pallets* - CAGES

These pallets were constructed by the firm LSK for transportation of the products of unequal shapes, light and frail materials, vegetables (e.g. potatoes), fish, meat, bags etc. Unit-built system of a box pallet is composed of two sides and two doors furnished with netting

which creates a cage together with a pallet. By means of locks with a special construction it is possible to join 2 - 7 pallets side by side with the help of sides and to choose the height of a cage till five layers as required. It is possible to fasten up the cage with a cover and secure by means of a lock or to seal. When the cages are empty, it is possible to take them to pieces and put together 4 of them into one.

#### add. 2 - Pallecon - SECURITY

Pallecon represents an innovated version of cages. It can be used everywhere instead of wooden cases earlier used for transportation of various frail or shapeless material.

#### add. 3 - Pallecon - LIQUID

It serves for manipulation, storage and transportation of liquid materials of various viscosity. It provides a secure transportation of liquids which are not classified as a combustible or poisons and the temperature will not overreach 70 degrees Centigrade during fulfilment, transportation and clearance. Liquid is fulfilled into a double casing plastic bag.

#### add. 4 - Pallecon - MINI BULK

It appears as the most appropriate one in Czech conditions as regards to the accelerated usage based on transportation research brought to effect operationally and on alternative possibilities of exploitation. It represents a comprehensive system of manipulation, storage, and transportation of dry, loose and cloudy material with a minimal portion of manual work. Statistical load-carrying capacity of this pallecon makes use of its stacking till 5 layers. Fulfilment is made in this way: a foil is situated in a built-up pallecon (never ending sleeve for one usage) so that it is closed in the lower part by replacement of the sleeve into a evacuate door. Material is then poured into the prepared sleeve in a required quantity. There are actually two ways of MINI BULK's clearance: gravitational and vacuum.

##### a) gravitational procedure:

- Pallecon with material is situated on a special tilting device, which can be operated in a pneumatical, hydraulical, electronical or mechanical way. Tilting stands are always constructed in such a way that there is a full clearance of a pallecon. During making use of the above mentioned stands, material is evacuated by the bottom door of a pallecon.
- Beside this way of discharging by the bottom door, it is possible to evacuate even by the top, by means of dumping - overturning of the pallecon about 180 degrees by means of a dumping gear.

##### b) vacuum procedure:

- With materials which can be poured easily, a pallecon after its installing into the tilting stand is tilted and material is sucked by means of a probe through the top.
- With the other materials after the removal of the cover, the evacuation is made with a simple sucking unit on a movable truck. Rotating paddles, copying the inner shape of the pallecon, rake the material below the sucking tube at the same time. Similarly as at the tilting stands, these procedures provide total exhaustion of a pallecon without any pollution or losses.

*The advantages of the manipulation system Pallecon - MINI BULK against the conveyance of loose, cloudy materials in bags, etc.:*

- elimination of painful hand work with bags and similar packing;
- perfect clearance (100%);
- easy fulfilment and exhaustion;

- possibility of stacking in five layers;
- there is not any pollution, depreciation of material during transportation, storage, manipulation (it is closed in a foil);
- possibility of batching according to the requirements (automatic weighing);
- no cleaning after the exhaustion of material;
- material is protected from weather effects, it can be stored in the open space;
- easy mechanical manipulation;
- easy hand assembly and dismantling;
- packing costs reduction;
- transport costs reduction during return transportation of a palletcon, because it is possible to put together four into one;
- better usage of a storage capacity;
- there is no need of any special device for fulfilment of a palletcon;
- one-shot foil usage;
- possibility of various dimension units' creation;
- enhancement of work safety.

Owing to the aptitude of palletcon's usage in the container transport system, making possible the application of favoured tariff rates in public railway, road and waterway transport, a trial production of the palletcon type MINI BULK has been started. The pallet with dimension 1000 x 1200 mm has been chosen as a basic load-bearing pallet (wooden flat). The palletcon's basic height will be 900 mm. These dimensions enable to deposit a big container ISO rank 1C with 20 pieces of palletcons in 2 layers totally.

Palletcons MINI BULK will be administrated by the plant KD - INTRANS that will hire them for some charge to the transport public due to the container tranship points - terminals, where palletcons will be put on and registered.

The transportation of the hired palletcons by means of vehicles and railway carriages will be ensured by the renter without any participation of the plant KD - INTRANS. In case that the hired palletcons will be transported in the containers ISO rank, the container carrier will accept these container consignments at the container transship points (terminals) and at the railway stations with forwarding competence for the entry and outgoing of container consignments. The charter of a palletcon will be started on the day of its takeover by the chartered from the lending office or from another chartered - transferor.

### **3. System of railway sidings**

The economy of railway sidings compared to road transport and in some cases to cable-railway or belt-transport is of a great importance both at the decision about the way of transport connection, e.g. new ev. reconstructed plants, big building sites etc. to the railway network and for appreciation of the current railway siding network, especially as regards to the progressive concentration loading and unloading into the smaller number of railway stations.

The volume of loaded and unloaded goods on railway sidings makes up about two thirds of total loading and unloading in tons in this country. Railway sidings network constitutes about 30% of railway tracks' length. The average constructive length of railway sidings is only 1.5 km and only a half of them has a allowable axle thrust as station's tracks, which embarrasses universal employment of carriages. Almost three quarters of the railway sidings has the turnover of carriage units less than five per day. Only one tenth of the total turnover of carriage units in railway siding network is implemented on these potty railway

sidings of small carriers. Great number of railway sidings does not correspond to operational and economical criteria.

There are two tasks consequent upon the review of railway sidings' economy compared to road transport:

1. to write up whether to connect a new reconstructed plant, a large building site etc. to the railway network by means of a railway siding or a road supposed that the transport fetch is to be constructed only;
2. to call in question whether it is useful to replace the railway siding transport with a small turnover by a road transport provided by a public road. According to the ratio between the costs in railway transport and road transport, it results that the road alternative is the more effective the shorter is the length of a railway siding and the smaller volume of transportation is on it.

The way of tranship is an important element featuring the costs in the frame of combined conveyances. An appropriate mechanization of transshipment in the stations of concentrated loading and unloading or in the terminals makes it advantageous just for these conveyances.

#### 4. System of containerization

Containerization is a carriage and handling system which uses containers for creating bigger handling units manipulated by automation means.

A *container* is a means of transportation with a bigger volume than 1 m<sup>3</sup>, transferred from one means of transportation to another one without transferring the material in it. It is usually adapted for stocking. It means a transportation, handling, protecting and storage cover which can be used repeatedly.

An essential condition for applying this system is *standardization of the main parameters of all parts of the system* that means - containers, automation machines and means of transportation.

These conditions are laid down in appropriate international recommendations ISO - International organization of standardization, in our country it is laid down as „ČSN“ - the Czech state standard.

In the Czech Republic this standard container transportation system is carried on the basis of universal container ISO IC, which is used in the international transportation as well. It is a box with frontal doors or frontal and side doors. It has a steel construction, wooden floor and is adapted for handling by automation equipment of ISO system, first of all electromechanical jacks, portal cranes rails - that is a special equipment for transferring containers called Klaus.

Basic technical data of this container ISO IC:

length: 6 055 mm, high: 2 435 mm, width: 2 435 mm, total weight: 20 320 kg /weight of container - 2 000 kg/.

Other containers have weight as follows:

1A - 30 000 kg

1B - 25 000 kg

1D - 10 000 kg

1E - 7 000 kg

1F - 5 000 kg.

Besides box universal containers various *special containers* are used according to carried materials for example: tank, isothermal, refrigerated, platform etc.

Containerization plays a very important role not only in domestic transport of goods and materials, but also in international transport. *Its advantages are especially:*

- a speeding up of transport, reached first of all especially reducing by loading and unloading,
- on tranship points - at terminals, railway stations, in docks and by purchasers/customers,
- optimal utilization of loading capacity of means of transportation,
- minimal handling goods from the consignor to the purchaser/customer /there is no transshipment/,
- reducing cover materials costs,
- applicability of containers as temporary storage space without a necessity to construct storehouses,
- reducing the risk of damage or loss.

Using a container transportation system requires besides technical equipment as containers, handling and carriage means and tranship points - terminals, *launching a number of organizational measures and creating convenient operating conditions:*

- procedure of dispatching and receiving the material has to be adapted to the container system,
- the way of transport in the plant has to be changed /including internal transport/,
- within a framework of commercial relations to start using a container for transport,
- to provide reinforcing of handling area including access roads,
- using standardized containers.

*Generally speaking ISO container transportation is advantageous for carrying heavy substrate, for palletized substrat, for substrat which is difficult to be stored and needs a special cover. It is favourable first of all for hauliers who have no siding and have to take the substrat in and deliver it by lorries.*

Analyses showed that there are three groups of hauliers according to their suitability for container transportation system /KDS/ and ISO

1st group: Hauliers who do not need any investment and so they can join this KDS system immediately

2nd group: Hauliers who need some small investment activities

3rd group: Hauliers who have - from the point of view KDS - ISO system - a good substrat there are no technical conditions and its implementation would mean large investment costs.

In the Czech Republic only 15 per cent of hauliers who use KDS - ISO system which was run properly, that is the first group of hauliers which did not have to invest.

In the framework of technical-economical assessment, during checking up on transportation in selected transportation chains, a very considerable savings of an average costs of 1 ton. But demanded operational conditions prevent a fully utilization of containerisation run by ISO means in agriculture. Utilization of containers ISMO in agriculture is limited and it is possible only there where necessary conditions were created and that concerns only some material flows, mainly in the area of outside transport in the framework of commercial contacts - mainly in food-processing industry.

*In spite of this fact a container as a means of transportation and handling system is very important in agriculture.* It is a significant and rationalized facility in transportation and handling material. But agriculture needs such technical equipment of container system which respects specific conditions of agriculture production. These conditions are met especially by so called lorry-tractor system.

Transportation analyses in selected agriculture plants in previous years show that the capacity of transport and handling is increasing. The capacity of transport is growing twice more than the production itself. Loading operations remain to be a continuing problem - that means loading and unloading which presents 50 per cent of working hours in total which shows that loading operations are efficient and automated very little. This is a very unfavourable feature when car technology is being implemented. One of the possible methods for streamlining in agriculture transportation is containerization, solved on the basis of lorry-tractor system.

This way of transport in recent years in agriculture basic industries expended and proved their worth in a form so called interchangeable superstructures. They are for example a manure /and similar stuff/ spreader, manure tanker or a big capacity superstructure. It is fixed in four places which are the same as the tie points of the basic body of the dump truck. *It can be handled only when it is empty.* After standardization of chassis they will be suitable both for superstructures and containers as well.

Agricultural containers differ from classic containers ISO not only with dimensions and loading-carrying capacity, but especially by the handling ability.

Basic technological data of standardized agricultural container:

- length: 5 000 mm
- height: 1 000 mm
- width: 2 300 mm
- weight: 10 200 kg.

The essence of the system is based on repeated using of a container as a transport-handling unit in the whole materials flow, where the transfer is missing, where the materials are transferred between individual trailer that is by a lorry /on a lorry chassis/ or a tractor /on a tractor container saddle trailers/. This transport of a container is made by the same handling equipment of both trailers and by the use of containers with a standardized chassis.

Containers used in agriculture are constructed for transport of diverse materials - in pieces, powdered or liquid designated for certain working operation or as a living unit for special purposes in distant workplaces /as a cloakroom, for having a rest, as workshops etc./ The most frequently used containers in agriculture are *tank* containers for storage and transport farmyard manure. In comparison with other containers these containers are the most frequent. But also another modifications are used - such as *platform* containers /for transport agricultural machines, caterpillar tractors, prefabricated parts, ISO containers etc./ *platform* containers /for transport palletized materials in pieces/ - also with a sheet, rail *tank* containers /for transport and pumping over chemicals and powdered substrates f.e. sugar, flour/, and *box* containers which can be used as reservoirs for green fodder, feed for adding food for animals in pastures as cistern tanks with feeders etc. There are about 20 modifications and this sum is not the final one.

*Manipulating a container is simple* - without demands of another mechanism and the procedure is this: a container which is lying as a rule on the ground is pulled over the tail end of the trailer by a handling device on the means of transportation and is automatically secured.



Arriving the place of destination a container can be emptied by back tilting or lowered on the ground again as an interoperational container or as it can be pushed out in a horizontal level on the ramp of the storehouse. All the manipulation a container provided only by a driver who does not need to leave his cabin because even opening the tail face is performed automatically. A replacement of two containers takes about 10 minutes.

The basic condition which has to be fulfilled in order to make handling containers on lorries or tractors possible, the unification of connecting proportions and gripping elements.

Containers made by our plants have cable /rope/ and one-armed system of pulling on adapted chassis of lorries or by tractors with a special container trailer.

*One-armed system* distinguishes itself by one arm at lengthways axle of a lorry or a tractor trailer which movement is in full control of one or two hydraulic cylinders. At the end of this arm there is an open hook which grips a container of a cable socket on a reinforced front face.

It is similar with *the cable system* but instead of an arm there is a cable.

*A classic way of container transportation ISO is performed mainly in the area of food-processing industry.* Analysis of hauliers' suitability in the food-processing industry in the Czech Republic according to substrats, the volume of transportation, distance, technology of production etc. shows that this is the best way of transportation:

- in sugar industry,
- in poultry farming,
- in canneries and distilling industry,
- in diary industry,
- in mills and bakeries,
- in breweries and malthouses,
- in adipose industry,
- in tobacco industry,
- in chocolate factories.

Limited conditions for development KDS - ISO were found out in the Czech Republic in hop-growing organizations and in all basic agricultural industries. Conditions for KDS-ISO system development in other organizations proved inconvenient.

## **5. System of combined transport**

In the Czech Republic further expansion of direct road transportation at medium and long distances where mainly transportation by lorries is very demanding and its considerable share on overloading roads communication by heavy transit traffic with a negative influence on our very unfavourable ecological situation. The development of transportation in the recent years in this country and in Europe concentrates on technical and technological reconstruction of transportation systems used at present and implementing combined transportation which enables a new cooperation in road and railway traffic.

*The expression system of combined transportation ISKPI* means transportation of interchangeable superstructures on chassis, trailers and accompanied and non-accompanied sets of wagons. With the connection of opening the Czech economy together with a heavy drain growing on our ecology road transport may grow up concerning mainly transit and inland transport, the inland one in east-west direction. The present model of *combined transportation* in the Czech Republic *characterizes* SKP as an integral system which uses its own technical means /wagons/, its own tariff conditions and a transport document and creating in this way

transport system which extends and completes appropriately existing progressive transport systems. Gradually it may be necessary to integrate all these systems. Although in the Czech transport system the main system in the area of combined transport road-railway-road, possibly river is considered a container system, the location of the Czech Republic in the very heart of Europe predetermines the Czech Republic also for the connection into European network of combined transportation, first of all transit, with a development of the present network inland /domestic/ combined transportation. Technical means for SKP involve also latest developed types of platform wagons with a lowered floor and smaller wheels, railheads well equipped by portal cranes, loading sides with storage areas.

*According to types of technical devices we devoid them into three types (wagons are different):*

1-st type - transport of lorries with trailers /or the whole sets/ with towing vehicles carried on platform wagons with a lowered floor. Loading and unloading of road vehicles is provided in horizontal way over an end-loading platform. A driver accompanies his lorry. In the Czech Republic f.e. accompanied combined transportation Rolo on railway line Lovosice-Dresden was established. The Bohemiakombi company has a considerable share on an implementation of this system. This company as an operator together with the Kombiverkehr Frankfurt company from Main, the Czech Railways and the Deutsche Bahn provides for a daily working according to a working flowchart of railway traffic in 1995/96 there were 12 pairs of trains a day, their number was regulated in days of rest. The time spent on this line is shortened now to 150 minutes. A place reservation ticket for a lorry is established for individual trains which is free of charge and means that every lorry which has a booked reservation is transported by a required train.

2-nd type of transport represents a transport of semi-trailers without towing vehicles loaded on wagons of type WIPPEN in horizontal way or on wagons with a „pocket“ in vertical way by crane or side conveyer move

3-rd type of transport means a transport of interchangeable superstructures of road vehicles Platform wagons which are suitable for transportation of containers are used for their transport. The advantage of interchangeable superstructures in comparison with containers is their own weight, but their disadvantage is that they cannot be stocked. *Handling is realized vertically* by a special crane with spring collector for gripping a carrying area of a load from below during transshipment from one means of transportation to another one. During transportation by a special trailer this one only underpasses the appropriate superstructure during loading and unloading, when it is standing on its four legs - its underpassing is provided pneumatically and that is why no crane is necessary in this case.

To further advantages of SKP belongs the fact that the number of towing vehicles will remain unchanged even in case of a growing demand for transport, because their circulation from one loading to the next one will be f.e. by transport of interchangeable superstructures lower than in classic way of transport. Implementation SKP makes reduction of manpower of hauliers who realize distant inefficient transport within their plant possible.

We can expect in the view of characterization of SKP that in future in the Czech Republic it will be used more efficiently and more frequently also referring to unfavourable situation at frontier crossings /waiting in long queues for customs clearance/ and its adverse influence on ecology. Utilization and introduction other lines Rolo is at present in the Czech Republic showed down by high tariffs required by the Czech Railways and unsatisfactory wagon stock which is suitable for realization of combined transport.

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### Resumé

#### PROGRESIVNÍ PŘEPRAVNÍ SYSTÉMY

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V článku jsou uvedeny jednotlivé progresivní přepravní systémy, a to jak stávající tak i nové, protože se od nich očekávají efekty zajišťující zvýšení efektivity dopravy. Jako první jednoduchý přepravní systém je prezentována paletizace s klasickými paletami a potom a potom nový technicko-ekonomický, skladovací, manipulační a přepravní systém PALLECON. Dále je posouzena i otázka hospodárnosti vleček. Vedle klasické kontejnerizace je uveden speciální zemědělský autotraktorový kontejnerový systém. Dále je vysvětlen systém ostatních kombinovaných přeprav, do kterého zařazujeme přepravu výměnných nástaveb automobilových prostředků, silničních návěsů a doprovázených nebo nedoprovázených souprav na železničních vozech.

### Summary

#### PROGRESSIVE TRANSPORT SYSTEMS

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In the article there are stated different progressive systems, either current either new one as far as it is expected, that their effects will increase effectiveness of transport. As a first single transport system there is presented palletization with classical pallets and also new technical-economic stocking, manipulating and transport system PALLECON. Further these is judged also question of economy of railway sidings. Except classical containerization there is introduced also special containerization system for agriculture. There is also explained system of other combined transport where we include also transport of interchangeable superstructures on chassis, trailers and accompanied and non-accompanied sets of wagons.

## Zusammenfassung

### PROGRESSIVTRANSPORTSYSTEME

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Im Artikel sind bestehende, aber auch neue einzelne Progressivsysteme angeführt, von denen die Erhöhung der Verkehrseffektivität zu erwarten ist. Zum ersten einfachen Transportsystem gehören die Palettierung mit klassischen Paletten, und dann auch das neue technisch-ökonomische Lager-Manipulations-und-Transportsystem PALLECON. Weiter wird auch die Frage der Wirtschaftlichkeit der Anschlussgleise beurteilt. Weiter wird hier ein spezielles landwirtschaftliches Autotraktorenbehältersystem präsentieren. Es wird hier das System anderer kombinierter Transporte erklärt, zu dem der Transport der Verkehrsmittel, der Strassenaufleger und der Begleit-und-Nichtbegleitsysteme auf Eisenbahnwagen eingeordnet.