

Air cushions enable the real flexible plant

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Today there is a fundamental change in the railcar industry. This change is characterised by deregulation, globalisation, strong decline of prices and overcapacities. This situation requires a higher flexibility in production and assembly within the companies, as well as new kinds of organisation and staff responsibility. The air cushion technique can make an important contribution to this.

By means of the air cushion technique, it is possible to achieve flexible modern manufacturing and assemblies concepts. In addition to this, innovative control techniques offer a wide range of possibilities for organising the production process. In this way, great rationalisation potentials will be set free, and this helps a branch of industries, such as the railcar industry to remain competitive.

In one of the most traditional railcar plants, the Deutsche Waggonbau AG (DWA) at Görlitz, the modern air-cushion technique is used for assembly and for chassis construction. The new final assembly, which was recently set into operation was up to now, with a volume of 22 million D-Mark, the biggest investment in the Deutsche Waggonbau AG. Already next year, they are going to produce beside the doubledeck railcars the first of the new high speed train generation with inclining technique (ICT), ("Pendolino"). By means of the air-cushion technique, which is also used at the other DWA-plants in Ammendorf and Bautzen (1), it is possible to organise a more flexible and effective production process for the railcar final assembly. This also obtains better working conditions for the operators in the 7.000m² large workshop and the introduction of team work.

For a range of tasks

However, the experiences made for example in the final assembly and the

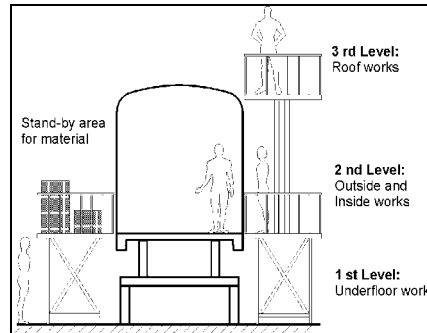


Fig. 1: Working simultaneously on three levels

paint shops, of the new railcar-repair companies and railcar plants in Weiden (2), Haarlem, Amsterdam (3), Hennigsdorf (4) and Vienna (5) have demonstrated that the classical model of a railcar plant is no longer suitable in comparison to plants which are flexible for the future and working economically. By means of the air-cushion technique it is possible to realise new plant-layouts and to apply new production concepts. One of the most important results of such production concepts is the turn away from Taylorism, that means the transition from line production to flexible station production as well as the introduction of team work and the flexible assembly station. By means of the air-cushion technique, it is also possible to realise a flexible plant. No fixed installations such as rails, assembly pits, cranes and transfer tables



Fig. 2: Autonomous working platform with an air-cushion gear, for the flexible use.

confine layout planning's, transport- and production sequences. Instead of that, the product now determines the most economical method of production. For this reason, all equipment is mobile on air-cushions so the production is able to adapt to changed requirements. For example, by introducing a standard height for the railcar body, which means that it is accessible from all sides (fig.1), it is possible to work on three levels simultaneously. This has many advantages: reduced processing time and underfloor work can be done in an ergonomic way (simple underfloor assembly of heavy parts).

This year in April, the railcar manufacturer ABB-Daimler-Benz Transportation (ADtranz) started production in a new plant with an investment of approx. 50 million D-Mark in Berlin-Pankow. 300 workers build railcars for the underground and suburban railways, tramways, regional trains, railway carriages, and doubledeck buses at this plant. This plant, with a capacity of ten assembly stations for respectively two railcar bodies, is equipped with modern machines, most of them based on air cushions.

Tape guided, autonomous, assembly platforms which are mobile on air cushions are used for all outside assemblies respectively for window and roof works (fig.2) The platforms are equipped with air-tanks so that they can work for more than one hour without a compressed air-supply. Furthermore the width of the platform is extendable in a range of 350mm depending of requirements to fit on the shape of the railcars. Mobile lifting tables on air-cushions are used for the pre-assembly of heavy parts as well as for the underfloor assembly of mechanical and electrical components (for example air conditioning equipment, transformers, generators and switch cupboards). Only one or two operators are required for the underfloor assembly as a result of

the mobility on air cushions and the ease of handling.

The mobile assembly facilities for windows and doors on air cushions also makes handling easy and simple, as well as saving a lot of time (fig.3). Automatic guided vehicles on air cushions controlled by a tape guiding unit are used in chassis construction, for the aluminium assembly of bogies, side walls and roofs. By means of radio transmission and a special control system (developed by DELU), it is possible to synchronise the movements of several AGV's on air cushions for the transportation of railcars (fig.4). This makes the air-cushion transportation system open for the different types of railcars because it is possible to link several AGV's via software. For long distances and narrow passages, the operator is supported by a tape guiding unit. To transport different railcars with and without bogies, only the transport aids have to be changed. For the use in railborne paint shops, the air-cushion transporters are equipped with an additional rail gear and additional in explosion protected execution.

For further reduction of the processing time, an autonomous measuring system on air-cushions was developed. Four independent lifting jacks equipped with load sensors are communicating via radio transmission with an analysing unit to determine the stressfree position of the railcar body as well as to determine the corner forces on the four-point supports.

This measuring system enables the measurement of manufactured railcars at any point in the assembly shop, thus the vehicle transport becomes unnecessary. This measuring system consists of a Master-unit and three Slave-units on air-cushions. The Master-unit is equipped with a force and displacement sensor, a computer, a monitor and a printer for reporting the measured and analysed values. It is also equipped with a radio control for the lifting system and radio data communication for receiving the measured values from the Slave- units. Each Slave-unit is equipped with a force and displacement sensor, radio control for the lifting system and radio data



Fig. 3: Door and window assembly aid using the omnimobility of an air-cushion gear

communication for the transmission of the measured values.

Through using radio control for the lifting system and radio data communication for the measuring system it is not necessary to install connecting cables. With this measuring system, it is possible to obtain maximum advantage from the flexible assembly stations. It is used for the first time at the ADtranz plant in Pankow.

A wide range of possibilities for organising the production processes

The flexible assembly station is the smallest organisational unit. It has the necessary know-how to produce a complete railcar from finished components. To a flexible assembly station belongs a team workers and two or three assembly stands. Each stand produces a railcar body. An important part of this assembly-method is the

internal self-organisation in groups with its own responsibility for costs, timing and quality. The team leader is responsible for the distribution of work at each stand, the production processes and the disposition of material. A team consists of between 20 and 25 workers. Them all can work on the vehicles. They can complete all work on the railcar and help each other in a way that supersedes normal work team possibilities.

This form of organisation results in a smooth equal charge of personal capacity and offers the team leader several possibilities to balance and optimise availability of capacity and resources. At the same time, these small individual groups are a transparent and simple operational and organisational unit within the factory.

On the economic side, in railcar manufacturing, the air-cushion based, flexible and group orientated production achieved the following results (according to various manufacturers):

- Between 20% and 40% increased productivity and reduced processing time, depending of the railcar type.
- Reduction in the cases of technical non-productive time, ancillary time and waiting time of up to 80%.
- 75% minimisation of transports.
- Up to 30% reduced warehouse stock.
- In addition to this, the invest in buildings and working stock in cases of building a new factory has been reduced up to 50%.

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Fig. 4: Tape guided AGV with air-cushion gear for the transport of railcars (Duo operating mode)