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Moving floors for WTPs

A less expensive and more performing solution than other systems

In waste treatment plants (WTP), moving floors (or "walking floors") are used to transfer, to store and to feed waste in a just-in-time process. Different WTP applications and various waste specifications ask for special machine characteristics. System advantages make moving floors a less expensive and more performing solution than other systems such as belt conveyors or push floors. RECYCLING m@gazine-Expert Winfrid Rauch analyses this technique.

Function principle

The moving floor (or 'walking floor') is a conveying principle that works on a discontinuing, pushing movement. A heap of products or materials lies on several (aluminium or steel) profiles. One moving cycle is composed by the following four steps:

1. All profiles advance together. Their motorisation is done by hydraulic cylinders which are positioned behind or under the profiles. The heap advances as far as the cylinders course permits it.
2. Theprofiles are linked to the cylinders. Normally, there are three cylinders. Each cylinder is linked to one group of profiles. Now, the first group of profiles goes back simultaneously. As the heap is supported by all profiles, the backwards movement of the third part of profiles is acceptable without any movement of the heap itself. In other words: the heap rests in the forward position because the partial return of the profiles has no impact.
3. Thesecond group of profiles goes back. The heap rests.
4. Thethird group goes back. The heap rests.

Moving floor applications

Moving floor technology comes from trailer technology. It is common knowledge that aluminium moving floors in trucks help to charge and discharge items. Their light weight and easy handling are in their favour for these applications. Trucks need their moving floor system only for charging or discharging moments, for example: one per day. Most instal-

lations in WTP work in the one or two shifts. Thus the moving floors are in constant use. WTP process conditions are different from those in trucks.

In WTPs, moving floors are used in stationary applications such as:

- MSW transfer station: An intermediate storage permits to distribute on demand waste coming from collect trucks going to 40 tonnes trailers.
- incomingstorage in WTP: a dynamic storage is needed to create a fluid WTP throughput. These moving floor bunkers possess often a kind of metering drum. This metering device helps to create a constant flow rate.
- Intermediatestorage: after main sorting steps, moving floor bunkers can be found under the sorting cabin.
- Outgoingstorage: in the end of WTP process, outgoing materials are put into bales or stacked for direct truck charging. This is often done for papers and cardboards.

Performances

The speed of moving floors is linked to the hydraulic unit. A standard hydraulic unit needs about 1.5 seconds to move three cylinders forward and nearly the same time to push back each of them. For one cycle, we can calculate with 1.5 seconds x 4 = 6 seconds for one complete movement. In one minute, we will have ten full cycles.

If we can move the heap forward about 100 mm (standard hydraulic cylinder course) in one cycle, we can forward it about 10 x 10 mm = 1 m / min.

Speed reduction is done by breaks between hydraulic movements. In this way, we can lower speed from 1 m/min to 0.5 m/min until 0.1 m/min or even 1 cycle in 2 minutes = 0.05 m/min.

The throughput of moving floors is characterised by the moving floor speed and the charging height. A conventional moving floor can be charged with about two meters of material heap.

So, we can calculate:

- speed:1 m/min
- heapheight: 2 m
- widthof the bunker (example): 2 m
- throughput:1 x 2 x 2 m3/min = 4 m3/min = 240 m3/h
  For a given density, we can define hourly throughput of materials. For example: paper and cardboards = about 200 kg/m3 = 0.2 t/m3




Product throughput = volume throughput x density = 240 m3/h x 0.2 t/m3 = 48 t/h.

This is a theoretical value because of following elements:

- heap height: normally the charging height is never stable.
- friction: sidewalls hold back the heap by friction.
- movement backwards: in the above description of the principle, it was assumed that the heap does not go back when one cylinder goes back. In reality, a little part of the heap (the bottom part) has a tendency to move back minimally.

The storage volume of a moving floor bunker is given by the following elements, for example:

- heapheight: 2 m
- widthof the bunker: 2 m
- length:6 m
- bunkervolume: 24 m3

In WTP conception, the feeding capacity is priority for the incoming feeding hopper. Such a feeding hopper should give a time-autonomy to the user thanks to its sufficient storage volume. While tipping from an incoming truck, the moving floor should not overflow.

Intermediate storage areas must be conceived according to downstream needs. For example, a baling press should bale all PET materials of one shift in one turn.

For the outgoing storage bunkers, other criteria will apply. For example, a trailer must be loaded in one turn. That means, a storage volume should contain easily the 90 m3 of the trailer capacity.

The installed power is quite little in comparison to other conveying systems. As described here before, the moving floor transports the heap only a little distance. Therefore, the effort is small.

The moving floor bunker with 24 m3 with speed = about 0.8 m/min needs a hydraulic unit of 4 kW.

Construction characteristics of moving floors

Due to the different applications, several types of moving floor models are used today. We try to give an overview of their characteristics:

- bunkervolume: the charging conditions give necessary widths and lengths. For transport reasons, moving floor manufacturers like to sell units that do not exceed a width of three metres and a length of 13 metres.
- profilematerial: aluminium is common in truck applications. For stationary WTP applications, steel profiles are used for heavy materials such as MSW, paper, cardboards, D3E, industrial waste and refusals. Steel profiles can support high charges are less submitted to friction and deformation. Aluminium profiles are often used for light materials such as PET bottles, PE, PP and PS products.
- leaktightness: In trucks, the floor has to be leak tight. Naturally, for this kind of use, a moving floor will have side seals. These seals might be o-rings or other sealing component which will be in contact with neighbouring profiles. In stationary WTP applications, experience shows that labyrinth sealings – or 'non contact seals' – may be more useful because of fine materials. Friction becomes important when waste is loaded with a high portion of dust, organics and little materials. Side seals will disappear and the floor will not be waterproof as it was in the beginning. Steel plates forming a labyrinth (never completely leak tight) maintain the original machine behaviour.
- hydraulicunit and cylinders: some manufacturers propose more than three hydraulic cylinders per machine. In some special applications, such as high duty performances, this configuration may be useful. In the standard WTP applications, three cylinders are sufficient to make the four step movement. The hydraulic unit and the cylinders can be put behind the moving floor. This is recommended when

the user does not have access under the floor. In all other cases, the standard configuration is done with cylinders under the moving floor.

System alternatives: belt conveyors and push floors

During the first Recycling Technology Seminary in Salzburg (August 2005), the companies TEAM Gruber (belt conveyors), FMW (push floors) and Matthiessen (moving floors) compared their technologies and machine characteristics.

Push floors (or 'sliding frames') can be found in flat silos of bulk materials. They are equipped with huge hydraulic cylinders that push several steel frames to and fro. The frames slide on a concrete floor and have the shape of a ladder with wedges.

During the forward movement, the material is moved into the direction of the cylinder by the blunt side of the wedges. So the bottom part of the heap will be pushed to the exit. This exit is normally a transversal screw conveyor.

During the backward movement, the wedges slide underneath the material, since in that case, the sharp side is moving forward. So the heap will not be pushed backwards.

Belt conveyors can be found in any application in WTPs. Their machine concept can be summarised by the following elements. The conveyor possesses a gear motor giving the traction on the conveyor belt. The belt receives its tension by the tension screw on the opposite end of the conveyor. The belt glides on a smooth steel plate or rolling units. The steel structure integrates sidewalls in order to improve throughput rates most of the times.

System advantages

In comparison to standard belt conveyor, the moving floor has the following advantages:

- width: standard belt conveyors rarely go beyond two meters in width. A moving floor can easily make six, nine, twelve or more meters combing different moving floor units.
- charging height: standard belt conveyors have difficulties accepting heights beyond two meters. The belt and its backing structure must be conceived especially for this. The moving floors can accept – by their construction principle – material heights greater than three meters.
- price: moving floors are less expensive for heavy materials (papers, MSW, incoming mixtures) if the storage volume is higher than 20 m3.

In comparison to push floors, the moving floor has the following advantages:

- principle: the wedges of the push floor are in the heap; they move the heap inside. The profiles of the moving floor are under the heap; they support the heap without any movement inside of the heap. Mechanically speaking, this means in the first case high duty (strong hydraulic cylinders) and in the second case low efforts (little hydraulic cylinders). Installed power will be different.
- large items: as the push floor works inside of the heap, it may encounter problems with large, heavy items. The moving floor moves forward any kind of material.
- price: in flat silos, push floors are installed. Often, their price is not high when the purchaser counts only the sliding frames and not the concrete works to make the bunker or silo floor. Moving floors are part of the bunker floor. They replace the concrete floor itself. Experience shows that in medium range storage volumes up to 150 m3, moving floors represent a more economical solution. For bigger bulk storage silos, push floors are certainly more interesting. In WTP applications for huge storage volumes, one would use loading and discharging machines such as grapnels, loading engines, conveyors or shovels.

Moving floors are a good solution and an essential parameter for the design of WTPs storage and conveying devices and of their exploitation costs. Detailed analysis is necessary to evaluate the comparison with alternative solutions. v

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