Collection & Transport Interest Group
A specialist Interest Group within the Institute of Waste Management of Southern Africa
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INSTITUTE OF WASTE MANAGEMENT: COLLECTION & TRANSPORTATION INTEREST GROUP

WORKSHOP TO DISCUSS STANDARDIZATION OF BULK CONTAINERISED WASTE HANDLING SYSTEMS

(Held in Pinelands, Cape Town on 18th July 2013)

WORKSHOP NOTES

An afternoon Workshop was held in Pinelands, Cape Town on 18th July 2013 to discuss the merits for developing specific guidelines for the standardization of large, bulk, containerized waste handling systems. The meeting was attended by sixteen persons representing manufacturers, suppliers, contractors, waste practitioners, consultants and municipal officials from various centres around South Africa.

1. Introduction

The Collection & Transportation Interest Group (CTIG) of the Western Cape Branch of the Institute of Waste Management of Southern Africa has, through its membership, been made aware of different standards being employed in the containerized waste handling industry, especially with respect to the bulk handling, transfer and transportation of large open-top and closed-top steel containers. This situation has led to incompatibility problems between the various components of handling systems, i.e. containers, compactors, container loading magazines and turn-tables, hook-lift equipment, slave vehicles, transportation vehicles and trailers, cranes, etc.

The CTIG Committee undertook to arrange a Workshop Meeting to explore the need for a Guideline that can be used by solid waste practitioners in South Africa to assist designers, manufacturers, suppliers, contractors, operators and local authorities in avoiding the high

costs associated with rectifying or replacing unsuitable and incompatible waste-handling plant and equipment.

2. Background and Problem Definition

Stricter environmental and waste management regulations and requirements in South Africa has resulted in the closure of many non-compliant landfill sites and the development of regionalized waste disposal facilities, usually located further away from the sources of waste generation. Consequently, wastes have to be transported over longer haul distances and waste transfer stations are needed to reduce the cost of waste transportation. There is therefore a growing need for waste handling and transportation systems, where optimal payloads can be achieved and where efficiency reliability and cost-effectiveness are important criteria.

A typical scenario in the municipal sector is described below, which may comprise the collection of general solid waste from residential, commercial and industrial areas and taken to transfer stations where the waste is compacted directly into closed steel containers, loaded and transported to a landfill site for disposal. Plant and equipment that may be involved includes:

- Steel Containers: Open or closed top, manufactured to various different lengths, widths, heights and capacities and with different lifting, sub/super-structure, door and locking device design and construction.
- Container turn-tables, loading magazines or slide rails.
- Waste Compactors.
- Container Slave Vehicles (at transfer station) fitted with hook-lift handling systems.
- Transportation vehicles fitted with hook-lift handling systems and trailers
- Container Slave Vehicles (at landfill site) fitted with hook-lift handling systems.

A single container loaded at a transfer station, transported to a landfill site and returned empty to the transfer station may undergo 10 to 14 lifting and lowering operations per trip cycle, depending whether or not a trailer is used. Furthermore the position of the container on the transportation vehicle and/or trailer during haulage will influence the optimal payload that is compliant with road ordinance regulations.

Given the host of plant and equipment involved in the above scenario, it is important that the handling operations take place in a seamless way, taking safety, payloads, compatibility, inter-changeability, reliability, cost and lifespan into account.

A problem currently being experienced in the waste-handling sector is that there is no accepted standard universally applied to the design, manufacture and supply of equipment such as outlined in the above scenario. The consequence is that operators, contractors and sub-contractors' plant often does not match the specifications of the containers (or visa versa) and often, within the same municipality or organisation, it has

been found that different facilities use different standards resulting in non-interchangeability and incompatibility.

It is recognized that certain waste management organizations and municipalities prefer to have their own "in-house" standards for various reasons such as security, or to avoid the cost of modifying existing plant and equipment, or manufacturers whose equipment is produced to specific company standards.

3. Objectives

The Key Objective of the CTIG initiative is to find industry consensus regarding standardizing certain design criteria related to waste handling plant and equipment and if the need exists, to develop a Guideline articulating the findings arising from responses received from relevant stakeholders and to distribute the Guideline through the umbrella of the IWMSA and to review and update the Guideline on an on-going basis.

It is not the intention of the CTIG to develop a comprehensive Standard covering all aspects of the design and manufacture of all waste-handling systems for plant and equipment, but to identify and recommend the use of certain key dimensions or specifications related mainly to interfacing aspects. Furthermore, the focus relates to the handling of large, bulk, open and closed top steel containers that are transported to waste disposal sites by road.

4. Workshop Discussion

Mr P Novella, Manager of the City of Cape Town's Solid Waste Disposal Department, presented a background of the City's growing need for bulk transfer and transportation of solid waste and highlighted some of the technical problems that have occurred as containerised waste-handling technologies have been introduced into the City over recent years.

Mr J Coetzee of Jeffares & Green (Pty) Ltd, engineering and environmental consultants, and Mr L Du Toit of Akura Engineering (Pty) Ltd, presented a number of specific examples of interface problems recently experienced with containerised waste handling systems at various facilities in South Africa. It was noted that different municipalities and contactors around the country have adopted different "key dimensions and standards" and that differences even existed within the same organisation.

The presentations were followed by valuable interactive discussions on various problem areas and short-comings in the bulk waste handling industry regarding interface and non-standardization issues. The workshop meeting concluded the following:

- The workshop had focussed on large, bulk containerised handling systems for municipal solid waste, but recognised that there is nevertheless a host of other waste management container handling systems that were not discussed, some of which may, or may not, have similar problems and issues.

- The manufacture and supply of mechanical plant and equipment in South Africa in the waste management industry can generally be regarded as being of a good quality and of a high standard. Provided a Client's specifications and requirements are clearly articulated, there a number of companies that can manufacture (or source from other countries) and provide "fit-for-purpose" plant and equipment that is robust, compatible and cost-effective.

- The majority view of the meeting was that **it would not be prudent to develop, or enforce a common standard for bulk waste handling systems** as there already exists a high investment in plant and equipment that would be expensive to re-fit, and other reasons such as security, choice of manufacturers who have their own company standards, etc. could result in a negatively affect should a common standard be enforced. However, it was acknowledged that any given municipality or contractor organisation should be aware of the compatibility and inter-changeability requirements, implications and constraints and should strive to have a uniform/common standard (e.g. a slave vehicle at a landfill site should be able to handle all containers delivered to the loading apron, or a transportation vehicle and trailer should be able to safely load, transport and unload all containers from a given waste facility).

- The meeting agreed that the key issues discussed should be noted and a copy of the meetings notes distributed to attendees and interested parties through the secretariat of the IWMSA. These key issues are set out in Section 5 below.

5. Key Standardized Criteria

Certain key areas of concern related to components of bulk solid waste-handling plant and equipment were noted and are described hereunder. These key areas were identified on the basis of known interface problems having been experienced in the waste industry.

5.1 Containers (large, steel, closed or open top, receiving compacted waste)

The focus is on solid waste handling employing large steel containers (A typical example is a closed-top, steel container approximately 6,0m long, with an internal volume of approximately 27-30m^3 and a total mass, once loaded, of 16-20 tons, designed specifically for hook-lift handling). The workshop discussion excluded the design and manufacture of containers utilizing cranes, side-loaders, forklifts or other lifting systems.

- **Body Construction**

  The body is typically designed for a minimum lifespan of at least 10 years of continual use, based on at least three cycles per day consisting of filling at a

Refuse Transfer Station (RTS), discharging at a landfill site and returning to the RTS.

The design of the container would aim at being a light as possible without compromising structural strength, while providing a maximum waste payload that meets road ordinance axle load requirements (typically 12-15 tons payload, depending on the mass of the container, the efficiency of compaction and the design characteristics of the transportation vehicle). For a 6,0m length empty container, weights typically vary between 4,250 kg and 5,000 kg.

Each container would typically incorporate an inlet opening (port) which is compatible with the compacting machine with a vertical sliding filling door. The filling door should incorporate a cutting edge to ensure full closure of the door under normal loading and compaction operating conditions ensuring that no waste remains exposed on the outside of the container after the door is securely closed.

The containers are typically fabricated from mild steel and designed such that at least 150% of all specified loads can be taken without deformation or stress fatigue. The typical plate steel used is 4,5 mm for the floor and 3,0mm for the roof and sides, with an ultimate tensile strength 0f 430-500 MPa. Containers are fabricated in accordance with various standardized steel manufacturing specifications commonly used in South Africa. The insides of the container body should be smooth on all four sides and may taper towards the tipping discharge door to ensure that the contents flow freely when being discharged. No internal bracing or protrusions should be allowed that will increase the friction of the waste being loaded and unloaded.

The inlet end should incorporate structural members to suit the clamping mechanism of the compacting machine, designed to withstand at least 150% of the maximum load specified during filling and compacting in the container.

The structural frame for the containers should be designed for the type of lifting/handling system to be employed, e.g. a hook-lift loading/unloading application (A-frame design philosophy). The size and position of the lifting hook as well as the size and spacing of the sub-assembly sliding rails should be compatible with hook-lift transportation vehicles commonly used by transportation containers in South Africa. The design should also be compatible with the container loading magazine associated with the transfer station compaction equipment.

There are different types/designs of large steel containers manufactured in South Africa or imported from overseas that are generally adequate to meet the requirements for use under South African conditions. User authorities such as municipalities need to ensure that their specific requirements for durability and life-span, mass and volumetric criteria, compatibility, safety requirements during handling and transportation, door and port details, requirements for prevention of

leachate spillage, types of materials and corrosion protection, compatibility with associated plant and equipment, etc. are clearly specified when procuring new containers.

- **Lifting Pin**

The containers described above would typically incorporate a lifting pin arrangement suitable for hook-lift loading and unloading operations. The lifting pin construction has been recognised as a chief area of concern in terms of compatibility, inter-changeability and failure due to operational wear-and-tear.

The location of the lifting pin relative to the container body is vital should compatibility and inter-changeability be necessary. The height of the container above ground (or bottom level of the container) and its distance from the front face of the container are crucial for proper hook-lift operations.

Inter-changeable or swivelling lifting pins would be a strong advantage, but due to cost considerations, fixed-welded solid round bars are more commonly used nationally and internationally. These bars should be fabricated from the hardest, weldable, mild steel commercially available, eg, BMS or EN9 steel (may be surface-hardened) and should preferably have a 65mm diameter to achieve a longer lifespan). Open containers would normally use a 40-50mm pin due to their lighter mass. The bars may be straight or curved. A practical minimum spacing apart of the pin supporting brackets (say 300mm) is recommended to assist engagement by the slave-vehicle and transportation vehicle operators. A "bashing" plate (10-16mm) should also be provided behind the pin to protect the container body against mechanical damage during loading-off-loading operations.

Investigation by Akura Engineering has shown that the following pin location dimensions are currently used in South Africa:

Source/Location	Pin Height (X) mm	Pin Diameter (mm)	Pin Height - Pin radius (mm)	Pin Clearance (mm)
DIN 30 722	1570	50	1545	200mm
Western Cape	1500	65	1468	140mm
KZN	1500	65	1468	?
Durban Solid Waste	1500	65	1468	210mm
Johannesburg	1510/1590	65	1478/1558	?
French Marrel System	1450/1400	50	1425/1375	?

(The above values should be checked and verified before committing to the manufacture of new containers).

Hook height is measured from the centre of the pin to the bottom of the container construction (sub-assembly). The diameter of the pin should also be taken into account when determining the height dimensions.

It is recommended that a standard be considered, where no other conflicts exist, with a Lifting Pin Height of 1500mm, a Pin Diameter of 65mm and a minimum clearance dimension of 200 mm (between the face of the bash plate to the face of the lifting pin).

- **Sub-structure Rails**

The container would typically incorporate sliding rails fixed in a sub-assembly and wheels suitable for hook-lift loading and unloading operations. Provision should be made for clamping the containers securely to the road transportation vehicle for safe conveyance. A Key area of interface and compatibility is considered to be the spacing apart of the sub-assembly slide rails, as loading magazines, slave vehicles and transportation vehicles and trailers use the slide rails for handling:

Source/Location	Slide Rail Clearance (Y mm)
DIN 30 722	1065
Western Cape	1050
KZN	1100
Durban Solid Waste	1100
Johannesburg	1590

The slide rail clearance is the outside dimension of the slide rails.

(The above values should be checked and verified before committing to the manufacture of new containers).

It is recommended that a standard be set, where no other conflicts exist, with a Base Width rail clearance dimension of 1100 mm.

- **Doors**

A pivoted outlet door would be provided at the same end as the filling port so that the waste is compacted against the solid rear end of the container, i.e. the container must be filled and emptied from the same side of the container. The design of the sliding filling door should be sufficient to overcome a pressure on the full door area from within.

The opening and closing of the discharge door should be a single-person operation without danger of swinging or slamming when unhooked. In the open position, the door should be held back with a retaining device as well as a back-up chain. When the door slides to the closed position, a door catch should engage the door automatically, enabling the operator to manually close and lock the door without holding the door. The door opening and locking device must be a hand-operated hydraulic or ratchet device, in the event of having to open the door manually. The discharge door should be lockable in the closed position during transportation. A robust protection shroud should be provided to protect the locking device from being damaged during handling and transportation operations.

The discharge door must be sealed so as to prevent leachate from spilling from the container, as well as to contain odours. Rubber seals are typically used to provide an effective seal.

- **Wheels**

It is common practice for wheels to be provided at the rear end of a container. Given the high loads imposed on the wheels during operations, the design, strength and durability of the wheels are important criteria. Failure of wheels bearings and supporting elements are commonplace, as well as damage caused to loading apron slabs. The width of wheels provided should be carefully considered (DIN 30 722 recommends a wheel width up to 300mm).Wheels should be designed to enable greasing to take place.

It is recommended that a standard be set for a minimum 250mm OD wheel width dimension.

5.2 Hook-Lift Systems

There are many different types and variations of hook-lift systems currently being used in South Africa and internationally. The DIN 30 722 Standards (2007) provide a comprehensive set of specifications with Series 1 covering 26t hooks (recommended for large/heavy closed containers), Series 2 for 32t hooks and Series 3 for 10t hooks.

It has been found that fixed 65mm diameter container lifting pins are subject to high abrasion “wear-and-tear” damage. This could be alleviated by having a properly designed hook (in terms of shape and profile) with an appropriate width (to increase the impact load contact area) and the inside edges of the hooks bevelled/rounded.

A minimum hook width of 50mm is recommended.

5.3 Slave Vehicles and Transportation Vehicles

There are a number of companies operating in South Africa that specialise in manufacturing and supplying slave vehicles and transportation vehicle-and-trailer combinations. Slave vehicles are specifically designed to function off-road, to operate under specific transfer station and landfill site conditions. These vehicles need to be robust and manoeuvrable to facilitate container loading and off-loading operations and are structurally designed to accommodate the mass of heavy fully-loaded containers.

The transfer container transportation vehicles and trailers are designed to specifically haul heavy containers over long-haul distances by road. The hook-lift system, supporting rails and container locking devices are designed to be compatible with the associated container specifications, to ensure safe transportation of the containers and to optimise the payload capacity within road ordinance limitations and requirements.

The clamping of the containers securely to the road vehicle for safe transportation, is a critical aspect in terms of safety and legal compliance. There are many different locking methods available and used in South Africa (e.g. mechanical locking pins, hydraulic systems, etc.), and operators and owners of transportation vehicles should ensure that a safe, robust and effective locking system is installed and maintained on all vehicles and trailers at all times. Included amongst those locking systems suitable for large waste containers, more commonly used in South Africa, are:

- Duncan-Mech Locking System
- Marrel locking shoes
- Akura Locking System (hooks0
- Hydraulic Locking clamps (inside/out or outside/in)
- Various other mechanical slocking systems

6. Meeting Conclusion and Way Forward

The meeting concluded that it did not support the development of a Standardized Specification for plant and equipment used for bulk waste handling systems for general/widespread use in South Africa. However, it was acknowledged that the larger bulk-handling users such as institutions/municipalities, etc. should adopt a standard for their own use so as to obviate problems of incompatibility, non-interchange-ability and unnecessary costs. Such a local/departmental standard of key dimensions and requirements should be readily available to the designers, manufacturers and suppliers of such plant and equipment.

It was furthermore agreed that it would be an advantage to the Industry if the main role-players in the industry could add their key dimensions/requirement/inputs to these

Notes/Report, and that the Report reside within the IWMSA for easy access by the Industry. In this way, all relevant parties could benefit and fruitless expenditure for rectifying incompatible plant and equipment could in future be avoided.

Mr R Spillman, Chairman of the Western Cape Branch of the CTIG, thanked the presenters and Workshop attendees for their constructive and meaningful participation and hoped that the final outcome would serve to benefit the waste industry.

7. References

- DIN 30 722 (Series 1-4): Roller Contact Vehicles up to 26t; roller Containers Type 1570 made from steel. April 1993 (DK629.114.79: 621.869.886).
- IWMSA Standardization: Specifications for 6,0m^3 to 11,0m^3 Open Containers (May 1999).
- CHEM GUIDE: Container Handling Equipment Manufacturers Association (UK) Issue No.3 April 2003.

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