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PALLET CONTAINER

The invention relates to a pallet container having a thin-walled inner receptacle preferably made from thermoplastic material for the storage and transport of fluid or free-flowing goods, wherein the plastic container is closely surrounded by an outer cage jacket as a supporting casing of intersecting pipe bars and a bottom pallet on which the thermoplastic receptacle is supported and which is firmly connected to the supporting casing.

10 Pallet containers, for example, those of the type having a top filling opening and a lower discharge valve in the inner plastic receptacle, and an outer cage jacket of strong vertical pipes or, an outer cage jacket from vertically and horizontally welded pipe bars are generally known. For example, from EP 0 695 694 A (W) a pallet container is known having a cage jacket made from
15 strong vertical pipe bars that have a round- or oval-shaped cross section. The vertical pipes are at each their upper and lower end bordered by a horizontally surrounding pipe, whereby the lower horizontal pipe is fastened to the bottom pallet by means of overlapping clamps. A pallet container with a welded cage jacket is known from EP 0734 967 (Sch) known. There, the pipe bars have a
20 circular profile, that is highly compressed at the welded intersecting points. From DE 297 19 830 U1 (VL) another pallet container is known having pipe bars with a different cross sectional configuration, but which is specifically intended to have a uniformly shaped cross sectional profile throughout the entire length of the bar



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without any indentations or dents which would reduce the shape of the cross sectional profile of the bar. A further pallet container with a cage jacket made from square-shaped pipe bars is known from the EP 0 755 863 A (F). There, in the area of the pipe intersections, the square-shaped pipes are only partially indented by
5 about 1mm so that a four point weld between the opposing straight side walls of the pipes can be realized, and that after welding, the level side walls of the pipes can be again in contact. Finally, from DE 196 42 242 (R) a pallet container with a welded cage jacket is known, the pipe bars of which consist of an open bar-profile, which at the outer walls is provided with straight laterally angled flanged rims that
10 are welded together in the area where the bars of the cage jacket intersect.

The cage jacket in the known pallet containers have an attachment at the bottom pallet which may be configured as a flat pallet from plastic or wood or as a steel pipe frame and is usually realized by attachment means such as for example, screws, brackets, clamps or grips that engage with the lower horizontally
15 surrounding cage bars. These attachment means are usually either nailed, riveted, screwed or welded to the upper plate or the upper outer edge of the pallet.

For industrial use, the pallet containers have to pass an administrative approval inspection and fulfill certain quality criteria. For example, the filled pallet containers have to undergo interior pressure tests and drop tests from specific
20 heights, which are also conducted at extremely low temperatures. The worst case drop is a diagonal drop onto the lower front wall of the pallet container where the bottom valve from the inner plastic receptacle is located. As has been shown in such drop tests, the inner plastic receptacle tends to become displaced relative to

the bottom pallett. Through the kinetic impact energy, especially at the front impact wall and the adjacent lateral surrounding areas, the pipe bars become severely deformed and certain attachment points of the cage jacket become torn from the bottom pallett. The attachment of the lower edge of the cage jacket to the bottom pallett thus poses an essential problem. Since the attachment of the cage jacket is provided only at a few pin-pointed locations, the cage jacket is prone to being unevenly deformed and buckles whereby the thin-walled plastic receptacle can be damaged by the severed pipe ends or the torn off attachment means.

10 Problem

Pallet containers or combination –IBCs (IBC=Intermediate Bulk Container) of the type discussed here are used in the transport of liquids. Preferably, they usually have a filling volume of 1000 liters and consist of a pallett, a stable outer metal pipe cage jacket, which is attached to the bottom pallett, and an inner receptacle from PE-HD which is tightly surrounded by the cage jacket, and which has an upper filling opening and a lower discharge armature. When transporting the pallett containers from the manufacturer to the filling station, from the filling station to the customer, from the customer to the reconditioner etc., the large-volumed containers are oftentimes loaded from the truck, or respectively the large container to conveyors, and have to be picked up and set down by a fork lift. During this procedure, accidents such as dropping the filled container cannot be ruled out. The transport vehicles can likewise incur accidents. In drop tests conducted during approval tests, the containers undergo great stress, for example,

when they are dropped from a height of about 1.9 m onto a steel plate. At such a drop, no load can be spilled and the cage jacket has to remain attached to the pallett after impact. This also applies to those „flexible IBCs“ with a flexible inner receptacle (i.e. a cloth sack) for granulate loads.

5 As a starting basis for the latest trends in the present invention, extensive serial tests were conducted with five pallett containers of the above-described different types currently available on the market which partly showed serious deficiencies, in particular as a result of the drop tests.

 It is an object of the present invention to propose a pallet container with
10 improved drop impact stability, which guarantees through simple constructive means an improved capacity against deformation of the cage jacket and thereby realizing a higher drop impact resistance, that is, for a one-time overload. In particular, the most sensitive spot at the container, the lower discharge armature should be better protected. A deformed pallett container that has been dropped
15 must remain absolutely liquid proof and has to be able to be lifted and handled by means of a fork lift without any problems. In addition, the pallett container should be suitable for the highest approval tests for dangerous liquids or respectively, free-flowing goods.

20 Solution

 In accordance with the invention, this object is attained by providing a pallett container with a cage jacket of steel pipe bars wherein the pipe bars of the cage jacket are especially configured for the event that the container is dropped,

so that at specific sites on the container, a plastic deformation of the cage jacket can be realised, without breaking or tearing off single pipe bars.

For a container drop at the front edge of the pallet where the discharge valve is located, it suffices that means for plastic deformation are provided only in
5 the vertical pipe bars.

In one embodiment of invention, the means for a plastic deformation of the cage jacket is configured as a bending point with a size reduction in the cross section of the pipe bar. The size reduction of the cross section of the pipe bar at the bending point can be realized by the asymmetrical indentation of the pipe bar
10 on one side thereof. In a preferred embodiment, the reduction of the pipe cross section at the bending point is realized through symmetrical indentations of two sides of the pipe bar opposing each other.

In accordance with the invention, protection of the discharge armature at the bottom side for realizing the bending points is provided by the indentations in
15 the vertical pipes bars at the two longer side walls and are formed parallel to the side walls, while the indentations for creating the bending points in the vertical pipes bars at the shorter front wall (at the discharge valve) and rear wall extends in a direction vertical to the front/rear wall.

A particularly desirable deformation pattern for a container drop is realized
20 when the indentations for producing the bending points are disposed directly above or below the intersection with a horizontally extending pipe bar.

In a preferred embodiment, the indentations for producing the bending points, are configured having differing depths. The depth of the indentations are

arranged such, that it is greatest above the lowest horizontally extending pipe bar, which is attached to the bottom pallett and decreases stepwise in the horizontally and surrounding pipe bars (when seen from below) that are further up.

Finally, in a more simple embodiment, the indentations are only provided in the immediate vicinity of the intersecting points with the three lowest horizontally surrounding pipe bars.

It is pointed out that as a special feature of the invention, the pipe bar profile is not indented directly at the welding point. The pipe bar profile is partially indented in the area next to the welding points, that is, at a distance from the welding points, wherein the indentations in the long pipe bars extend parallel, and in the shorter side walls (with the discharge armature) perpendicular thereto, whereby, relative to the welding points, a reduced bending section modulus is realized that serves to reduce stress at the welding connections at the intersections of the pipe bars when they are exposed to sudden stress.

The length of the indentations for producing the bending points is in the range between 15 mm and 45 mm, preferably about 30 mm, wherein the depth of the indentations at the bending points should be between 15% to 50%, preferably about 33% of the pipe bar cross section. Thus, the flexural strength of the formed pipe bar cross section is reduced by only a very reasonable amount, but the proneness to crack formation is thereby considerably lowered.

The invention is explained in the following paragraphs where further features and advantages are described in greater detail with reference to embodiments, which are illustrated in the drawings. It is shown in:

FIG. 1 a side view of a pallet container according to the invention;

FIG. 2 the pallet container according to FIG. 1 shown during a drop test;

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FIG. 3 the pallet container according to FIG. 1 at the moment of impact on the floor;

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FIG. 4 the pallet container according to FIG. 3 after floor impact;

FIG. 5 a detail view on an enlarged scale of the cage jacket side;

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FIG. 6 a schematic illustration of portions of the deformed cage jacket;

FIG. 7 a schematic illustration of the cage jacket according to the invention;

FIG. 8 a schematic illustration of parts of the cage jacket according to
20 FIG. 7 after the drop test of the pallet container; and

FIG. 9 various pipe bar profiles unshaped and shaped

In FIG. 1 referenced as numeral 10 is a pallet container according to the invention, which shows a thin-walled blow-molded rigid inner receptacle 12 made of thermoplastic material (HD-PE) with an upper filling opening and a cage of intersected pipe bars 14 tightly enveloping the inner receptacle, and which is firmly
5 – but detachably or respectively, interchangeably -- connected to the bottom pallet 16. The dimensions of the bottom pallet 16, or respectively the pallet container 10 are 1000 X 1200mm. The illustrated side view shows the longer side of the pallet container 10 with the discharge valve near the bottom in the plastic container 12. The (left) lower front edge of the bottom pallet 16 with the discharge
10 valve situated above represents the most sensitive point on the pallet container, and is being submitted to the greatest stress during the approval test, in particular during the diagonal drop test. In the circles as shown, the three pipe bar intersections are indicated with X, Y and Z, wherein the intersection labelled Z is disposed at the level A of the lowest horizontal pipe bar, the intersection Y at the
15 level B of the second horizontal lower pipe bar and the intersection Z at the level C of the third horizontal pipe bar seen from below. A discussion of these intersections follows.

The testing-pallet container depicted in FIG. 2 is submitted for testing purposes to a diagonal drop test; where the areas also marked as circles X, Y and
20 Z in the vertical and horizontal pipe bars are shown for illustration purposes only (as a detail) and which, according to the drop-test results, are submitted to great stresses, such that there occur a crack formation, and at various points, a pipe

break. Of course, a deformation occurs more or less in the entire region of the lower cage jacket.

FIG. 3 shows the test-pallet container 10 according to FIG. 2 at the moment of impact on the floor. Through the kinetic energy of the liquid load, considerable elastic and plastic deformations are caused in the construction parts of the inner receptacle 12, cage jacket 14 and bottom pallet 16. In FIG. 4, the test-pallet container 10 is depicted with permanent deformations after the drop test (according, to FIG. 3). In particular, the vertical pipe bars 20 are severely bent or buckled. The cage jacket 14 has been already displaced by about 150 mm at the second lowest cage jacket level B -- and in total (above) by about 200mm, relative to the drop impact edge of the bottom pallet 16.

FIG. 5 illustrates, that the marked intersections Y and Z (as well as also each of the neighboring ones) were laterally displaced downwards according to a parallelogram-kinematic, whereby the horizontal pipe bars 18 show virtually no plastic deformation and the vertical pipe bars 20 exhibit a very severe plastic deformation. This severe deformation in the area of the marked intersections X, Y and Z is emphasized again in a schematic manner in FIG. 6. There, it is seen, that a vertical pipe bar 20 above an intersection always buckles at one side (in the figure towards the left side) and below the intersection always at the other side (in the figure towards the right side). The occurring buckling and shear tension forces are minimal at the intersection Z; they are higher at the intersection Y and are highest at the intersection X in the lowest cage jacket level A. The attachment of

the lowest horizontal pipe bar 18 at the pallett 16 causes additional shear stresses that must be absorbed in this area (intersection X).

The intersection X is a particularly weak area in the described drop-test and the vertical pipe bar oftentimes tears, or at higher drop heights, is torn off entirely.

- 5 The crack formation always begins from the side with the highest pull tension.

A sharp-edged crack area at the lower pipe bars can also lead to the damage of the inner receptacle thereby leading to leakage of the filling goods.

Another weak area may exist in the region Y. There, the inner receptacle can be jammed and also damaged when the horizontal bar B and the vertical bar are

- 10 being displaced by the 45 ° drop.

Prior to developing the pallett container according to the invention, five different types of pallett containers of the previously described pallett containers, which are for sale on the market, were submitted to precise comparative stress tests (inner pressure tests, drop tests, vibration tests, pressure tests required for

- 15 upsetting respectively for stacking). In conducting these serial drop tests, particularly frequently occurring weak areas in each of the cage jacket regions

have materialized. The extreme deformations at the vertical bars always appeared

directly at the welding points. In the field it has been shown, that the welding points

regularly survive the rigorous stresses of the drop tests, however, due to the

- 20 material brittleness and the additional shear stresses at the bending points - directly next to the welding points - the vertical bars frequently crack or tear off.

FIG. 7 is a schematic representation of showing the means for improving the deformation pattern in a dropped pallet container according to the invention.

The vertical profiled bar 20 is provided with indentations 22 near the welding points at the intersections, whereby always at least one indentation 22 is provided between two intersections. The vertical profiled bar 20 is thereby reduced in width which means it is indented or, respectively constricted (at the cage jacket deformation level in the drop test).

Effect: Through indentation of the vertical bars next to the welding points at a selected area, a certain distance from the welding point, a predetermined weak point is being introduced, which absorbs the occurring bending stresses thus relieving the welding areas from the bending tensions. At a small distance from the welding points, the pipe profile is indented (about 3 to 5mm remain un-indented), which means, the bending occurs in an area, which is not embrittled from the welding operation. By configuring the vertical bars with the described indentations (cross section reduction), the drawbacks of the prior art as described become only apparent at considerably higher stresses respectively at elevated dropping heights.

The depth of the indentations for forming the wanted bending points can be maximally about 50% of the pipe cross section. The total indentation depth (even with two-sided indentations) are about in the range of 15% to 50% of the width of the pipe cross section, preferably about a third (33%). Thereby the flexural strength of the indented pipe profile is reduced by a reasonable amount but the

possibility of crack formation or, the possibility that a pipe is perhaps completely torn off is considerably lowered.

At the side of the welding points, the indentations are configured comparatively steep and towards the other side become gradually flatter. An indentation of about 15 mm (= about 33%) is normally sufficient in a bar with a height, respectively a width of 15 mm, whereby the maximum of flexural stress is kept away from the welding point, but retains a sufficiently high stiffness in the pipe. This is important in order to keep a sideways shifting of the cage jacket, for example by interior pressure admission, as low as possible.

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FIG. 8 is a schematic representation of the intersections A, B' and C' according to FIG. 7 after the drop test of the pallet container according to the invention. The bending of the vertical pipe bars 20 are seen here in the area of the indentations 22. Through the reduced flexural strength in the indentations 22, the deformation of the endangered intersections, respectively the welding points shifted away towards the wanted bending point, such that directly at the welding point there is no longer any crack formation.

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As depicted at the bottom of FIG. 8, at the vertical pipe bar 20, an indentation 22 can only be formed at one side of the bar. In a preferred embodiment, a wanted bending point is realized through symmetrical two-sided indentation 22 (cross section reduction).

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Finally, in FIG. 9, six different pipe bar profiles are schematically represented with their respective indentations shown. The technical teaching in accordance with the invention is not limited to a certain pipe bar profile.

The un-indented „normal“ pipe bar profile is drawn in these partial illustrations each – in broken lines – and the areas of the indentations according to the invention are drawn in continuous lines.

FIG. 9a shows a preferred closed trapezoidal-shaped pipe bar profile 24 (M) (height/width = 18/15 mm) with high performance values with each of the conducted approvals. A possible further embodiment of the sideways indentation is referred to with 24'.

FIG. 9b shows a known open partial-trapezoidal-shaped bar profile 26 (R) with a possible indentation 26'.

FIG. 9c shows a known round pipe bar profile 28 (S) (diameter 18mm) showing an indentation 28', whereby the cross section reduction was carried out at each side and additionally carried out from the top and bottom.

FIG. 9d shows another known round pipe bar profile 30 (VL) (diameter 20mm) with an indentation 30', wherein cross section reduction is formed only by means of the indented sides.

FIG. 9e shows a square-shaped pipe bar profile 32 (F) (height/width 18mm) with a possible cross section reduction 32' by means of indentations on all four sides.

FIG. 9f shows a square-shaped pipe bar profile 34 and another possible indentation 34' wherein the configuration is symmetrical in the form like a four-leafed clover.

The invention can of course also be realized for the flexible IBCs with a
5 metal pipe cage jacket and for example, a cloth inner receptacle for use with granulated goods.

REFERENCE NUMERAL LIST

	10	pallet container	A	1. lower cage jacket level
	12	inner receptacle HD-PE	B	2. lower cage jacket level
5	14	cage jacket	C	3. lower cage jacket level
	16	bottom pallet		
	18	horizontal bar	X	intersection (A)
	20	vertical bar	Y	intersection (B)
	22	indentation	Z	intersection (C)
10	24	trapezoidal-profile		
	26	open profile		
	28	circular pipe-profile		
	30	circular pipe-profile		
	32	square pipe profile		
15	34	square pipe profile		

Patent Claims

1. A pallet container having a thin-walled inner receptacle from thermoplastic plastic material for storage and transport of fluid or free-flowing goods, wherein the plastic receptacle is closely surrounded by an outer cage jacket acting as a support casing and a bottom pallet on which the thermoplastic receptacle is supported and which is firmly connected to the support casing; characterized, in that special means are provided in the pipe bars of the cage jacket, such that should the container be dropped, a plastic deformation is realized at specific predetermined points on the support casing.
2. Pallet container according to claim 1, characterized in that the means for the plastic deformation of the support casing is provided only on the vertical pipe bars.
3. Pallet container according to claim 1 or 2, characterized in that the means for a plastic deformation of the support casing is configured as a bending point with a reduction in the size of the pipe bar cross section.
4. Pallet container according to one of the preceding claims 1, 2 or 3, characterized in that the size reduction of the pipe bar cross section at the bending point is configured as an indentation of the pipe bar from one side (asymmetrical).

5. Pallet container according to one of the preceding claims 1, 2, 3 or 4, characterized in that, the reduction of the size of the pipe bar cross section at the bending point is configured through indentation of the pipe bar of two opposing sides of the pipe bar (symmetrical).
6. Pallet container according to one of the preceding claims 1 through 5, characterized, in that the indentations for producing the bending points are configured in the vertical pipe bars of the two longer side walls in a direction extending parallel to the side wall.
7. Pallet container according to one of the preceding claims 1 through 6, characterized, in that the indentations for producing the bending points in the vertical pipe bars of the shorter front wall (at the discharge valve) and at the rear wall in a direction perpendicular to the front/rear wall.
8. Pallet container according to one of the preceding claims 1 through 7, characterized in that the indentations for the bending points at the vertical pipe bars are disposed between the intersecting horizontal pipe bars.
9. Pallet container according to one of the preceding claims 1 through 8, characterized, in that the indentations for producing the bending points are provided directly above/below the intersection with the horizontally extending pipe bar.

10. Pallet container according to one of the preceding claims 1 through 9, characterized, in that the indentations for producing the bending points are configured with different depth.
11. Pallet container according to one of the preceding claims 1 through 10, characterized, in that the depth of the indentation above the lowest horizontally extending pipe bar, which is attached to the bottom pallett is greatest and reduces stepwise upwards to the further horizontally surrounding pipe bars (seen from below).
12. Pallet container according to one of the preceding claims 1 to 11, characterized, in that the indentations are only formed in the proximate area of the intersections with the three lowest horizontalyy surrounding pipe bars.
13. Pallet container according to one of the preceding claims 1 through 12, characterized, in that the length of the indentations for producing the bending points is between 15 mm and 45 mm, prefereably about 30 mm.
14. Pallet container according to one of the preceding claims 1 through 13, characterized, in that the depth of the indentations at the bending points is between 15% to 50 % of the pipe cross section, prefereably about 33%.