

# MULTIFUNCTIONAL, REUSABLE X-BIN CONTAINER

Siniša Popović<sup>1</sup>, Denis Jurečić<sup>2</sup>, Branimir Jezdić<sup>3</sup>

<sup>1</sup>*Log Adria d.o.o., Zagreb*

<sup>2</sup>*Faculty of Graphic Arts, Zagreb*

<sup>3</sup>*Heavy Duty d.o.o., Zagreb*

## ABSTRACT

The development and production of the reusable X-Bin container, designed to replace wooden crates and single-use packaging [1], are presented in this article. X-Bin is an innovation in design which has the purpose of improving the distribution of goods presented to customers on pallets in stores.

X-Bin plays an important role in the storage, transport and sale of fruits and vegetables. Since the cost of packaging in the agricultural industry is not negligible, any cost reduction in this process can increase the industry's profit. Packaged fruits and vegetables can remain in cold storage for up to six months at low temperatures and high humidity. Cold storage requires the use of high-quality materials produced from high-quality raw materials. Previous studies and practical experience in cold storage facilities show that humidity significantly influences the firmness of the packaged product. X-Bin is therefore an excellent solution which eliminates the disadvantages of wooden and cardboard boxes in the conditions of low temperature and high humidity in the cold storage of fruits and vegetables.

In cooperation with the stakeholders in the supply chain (the producers of fruits and vegetables, transport companies, retail stores, etc.), different types of handling bulky goods [5], especially fresh goods transported in large packages, were compared. Through extensive analytics, a new type of handling of a wide range of goods, both from the food industry and from other industries, has been perfected. The reusable X-Bin container uses security design and security graphics [6] for a multilevel verification of authenticity both of the packaging producer and of the contents of the packaged product [3].

**Ključne riječi:** *reusable packaging, supply chain, packaging, collapsible container*

## 1. UVOD

This article was written as part of a project funded by the EU's European Regional Development Fund.



Communicating with producers of fresh foods (mainly fruits and vegetables), as well as retail chains, the buyers of those foods, we have directed the development towards the improvement of reusable containers for the packaging and transport of goods. This article deals with the handling and presentation of products in stores, especially with regard to the visual appearance of the packaging (whether it is crushed or creased), as well as with the access to the products for the buyers. Since the products are presented on pallets, the buyer can access the products at the bottom of the packaging – something that is much more difficult if there is no space intended for this purpose.

## 2. DEFICIENCIES OF THE EXISTING SOLUTIONS

The most common solutions intended for this purpose are made of extremely firm, seven-layer corrugated cardboard, the so-called heavy duty cardboard packaging. We have analyzed the deficiencies of the existing solutions with regard to their assembling and filling with goods, distribution, display in stores, issues with waste generation and management and commercial competitiveness.



**Image 1** Reusable X-Bin container for the packaging and transport of goods

#### a) Wooden crates

- the packaging is assembled at the place where it is filled with goods, generating additional human labor and expenditure of materials and time. The average time of assembly for a crate is 20 minutes, using the work of two people.

- wooden crates are suitable for storage and distribution due to their rigidity, sturdiness and the option of stacking one on top of the other

- in stores, wooden crates are problematic due to the poor access to the goods for the customer

- in waste management, wooden crates are difficult to manipulate and dispose of

- in terms of competitiveness, wooden crates are the most expensive solution for the user

#### b) Cardboard packaging

- the packaging is assembled at the place where it is filled with goods, generating additional human labor and expenditure of materials and time, albeit to a lesser extent than wooden crates. The average time of assembly for a cardboard box is 5 minutes, using the work of two people.

- in storing and distribution, in order to be firm enough for vertical stacking and optimal loading of transport vehicles in the case of more demanding goods, cardboard packaging has to have the following technical specifications\*:

- Cardboard grammage:	1400 g
- Burst:	2840 kPa
- Puncture:	25 J
- Edge crush:	19.9 kN/m
- Cardboard thickness:	12-13 mm

\* the measurement was done on cardboard packaging for watermelons which satisfied the requirements for vertical stacking of boxes during transport and storage

Moisture plays a dominant role in the firmness of packaging, so the state of packaging in conditions of regulated humidity and temperature is very important for the study of general systems of packaging with corrugated cardboard. Boxes with lower technical parameters collapse under the weight in storage and transport and damage or destroy the goods [2] (Image 2).



**Image 2** Corrugated cardboard boxes with lower technical parameters

- in stores, cardboard packaging is convenient for displaying goods because it can provide easy access to the products for the customer

- in waste management, it is difficult to dispose of due to its extreme firmness

- in terms of competitiveness, cardboard packaging is more competitive than wooden crates, but its cost is still relatively high since it must meet the minimal technical parameters



### 3. THE DEVELOPMENT OF THE REUSABLE X-BIN CONTAINER

A container which can be collapsed and taken apart is the acceptable solution for the disposal of empty packaging in the indoor or outdoor area of a store. This is very demanding in the case of wooden crates and somewhat less complex in the case of cardboard packaging. The biggest issue with large units of packaging is the work in the store necessary for the disassembly and disposal of the packaging. The innovation of the reusable container lies in: simplified packaging and transport of goods, firmness, disassembly, collapsibility and the marking with code. Our innovative solution under the name of “X-Bin” is elaborated in 10 sections:

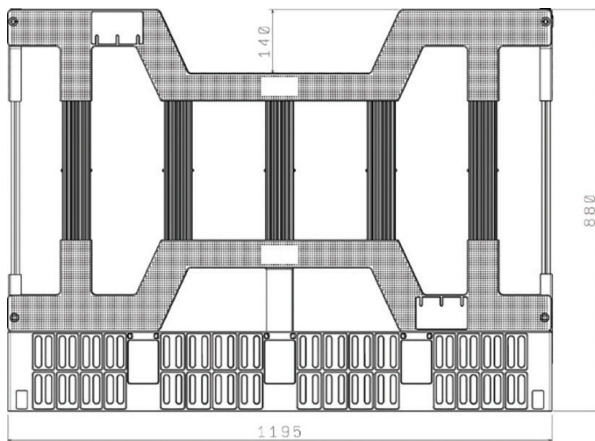


Image 3 Dimensioned drawing of the X-Bin solution

a) Firmness of packaging which ensures efficient use of transport and reduced unit cost.

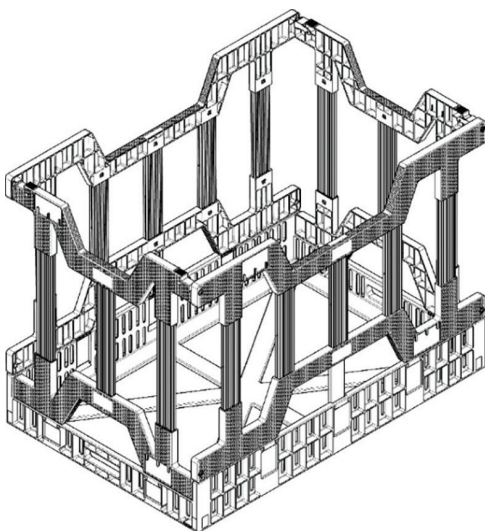


Image 4 Rendered drawing of the X-Bin solution

b) The packaging process is adaptable to the dimension of the Euro-pallet and the height of transport units.



Image 5 Fixators for the Euro-pallet

c) The reusable solution meets the criteria of environmental protection and reduces human labor in waste management.

d) X-Bin emphasizes the idea of a “collapsible solution”, which is commercially more attractive than the existing compact, voluminous solutions on the market.

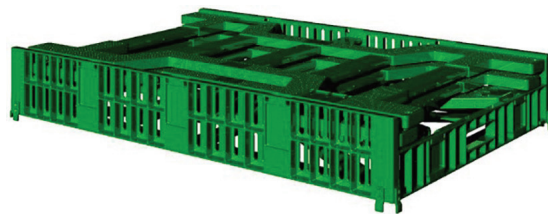


Image 6 X-Bin – collapsible version

e) X-Bin is made of materials suitable for sanitizing (washing) when it is needed for visual or health reasons.

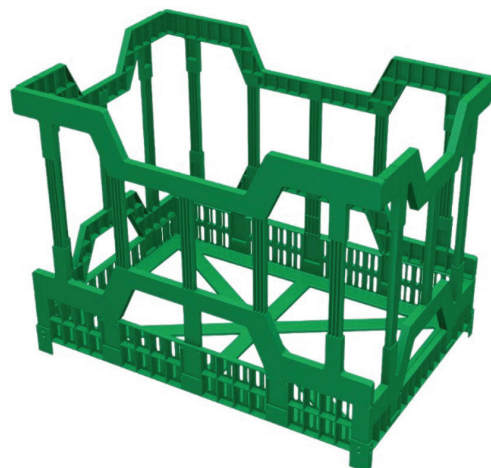
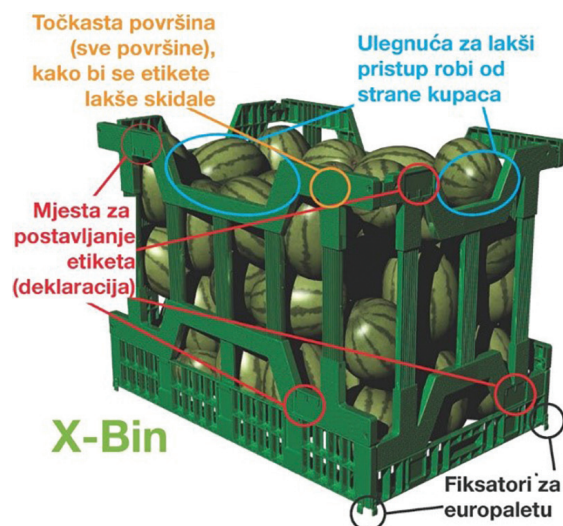


Image 7 X-Bin – version which can be taken apart

- f) It simplifies the assembly into usable form and the deposit form, i.e. the form of filled containers vertically stacked on top of each other
- g) It is ready for marking with logistical codes and security labels [4], obligatory information with retail products.
- h) The design and construction ensure that the container has the necessary space and possibility of communication with customers (ads, prints etc.)
- i) A method of searching and accessing goods has been developed so that the customer at the store can access the goods at the bottom of the container.
- j) Since the solution is reusable, the price for one use should be more competitive than for any other solution on the market, which is very important since one of the motives for the development of X-Bin containers was cheaper packaging of bulky goods.

The following programming tools were used for the model design and development: Rhinoceros, ArchiCad and Catia.



*Image 8 X-Bin – complete solution at a retail store*

#### 4. METHOD OF USE FOR X-BIN

A solution under the working name “X-Bin”, which met all the key goals, has been developed. X-Bin is made of HDPE (high-density polyethylene) and metal (aluminum) parts for maximum resilience to atmospheric conditions and ease of use in open spaces.

It is both lighter and easier to manipulate, all the while being firm enough for use. The testing of X-Bin was done in real world conditions, so X-Bin went through all the stages of a real distribution process, from assembly to filling, transport, storing and the store.

It should be emphasized that the possibility of commercial use for the X-Bin container has opened up in other segments of goods which are displayed on pallets, such as non-food products and various seasonal products and products on sale.



*Image 9 X-Bin – the option of vertical stacking of transport units*

#### 5. CONCLUSION

The X-Bin solution has accomplished many of the key goals, along with a few innovative suggestions. It passed the testing stage in real world conditions and received positive comments from potential users.



The success lies in the collapsibility, the ability to be disassembled, the firmness and the durability in the conditions of cleaning and washing in multiple uses. This solution is currently unique on the market because it was developed from start to finish with the goal of satisfying the needs of users in the entire supply chain, with emphasis on the final destination – the store. This approach to packaging was developed in order to enable the optimal flow of goods through the supply chain which generates the least amount of human labor and waste.

Still ahead of us are the process of small corrections after successful testing, the technical preparation of the first commercial product and the communication with the market which will give the final evaluation.

\*The content of the published material is the exclusive responsibility of Heavy Duty d.o.o.

## 6. REFERENCES

- [1.] Babić D., Jurecic D., & Popović S. (2004). Heavy Duty Packing as the Possibility for the Substitution of the Wooden, Metal and Plastic Packaging, 8. Savjetovanje dizajna i grafičkih komunikacija Blaž Baromić, / Bolanča, Zdenka; Mikota, Miroslav (ur.). Zagreb; Senj: Grafički fakultet Sveučilišta u Zagrebu; Ogranak Matice hrvatske Senj, str. 229-234 (međunarodna recenzija, objavljeni rad).
- [2.] Jurečić D., (2015). Istraživanje čvrstoće ambalaže od valovitog kartona u kondicioniranim uvjetima, doktorski rad, Grafički fakultet, Zagreb
- [3.] Denis Jurečić, Vilko Žiljak, Mensura Kudumović, Božica Kelčec Pester. Packaging with dual information for visual and infrared spectrum <https://doi.org/10.25027/agj2017.28.v29i2.158>; Acta graphica: znanstveni časopis za tiskarstvo i grafičke komunikacije, Vol. 29 No. 2, 2018.
- [4.] B Morić Kolarić, M Grgić, D Jurečić, P Miljković; Security Label for Aronia Juice scanned in near infrared spectrum blockade; <https://doi.org/10.19279/TVZ.PD.2017-5-4-02>; Polytechnic and design 5 (4), 256-262
- [5.] <https://www.tri-wall.com/our-business/products/>
- [6.] D Jurečić, V Žiljak, JŽ Gršić, I Rajković; Near infrared spectrography of colorants for offset printing with individualized rasters on drug packaging; <https://doi.org/10.25027/agj2017.28.v29i4.160>; Acta Graphica 29 (4), 7-12

## AUTHORS



### • Siniša Popović

Entrepreneur with several companies in the region operating in the fields of packaging and logistics. He graduated from the mathematical high school in Šibenik and

studied design at the Faculty of Graphic Arts in Zagreb. His portfolio includes some ten registered patents and industrial designs in the area of packaging innovations. He actively participates in projects in universities and business schools, as a lecturer or participant in projects, scientific conferences and papers. Recently his interests lie in logistical solutions in the segment of reusable packaging and distribution tools.

### Correspondence

[sinisa.popovic@elog.hr](mailto:sinisa.popovic@elog.hr)



• Denis Jurečić - Unchanged biography can be found in the journal Polytechnic & Design, Vol. 5, No. 4, 2017.

### Correspondence

[denis.jurecic@grf.hr](mailto:denis.jurecic@grf.hr)



### • Branimir Jezdić

Acts through the company Heavy Duty d.o.o., which primarily operates in the segment of packaging and development of special solutions for specific segments of packaging. The

focus of his work is on further development of the segment of complex packaging, which combines several branches of the packaging industry which use different materials in order to achieve one, optimal packaging solution.

### Correspondence

[branimir@heavyduty.hr](mailto:branimir@heavyduty.hr)