TRANSFORMING MATTRESSES

FROM WASTE TO RESOURCE

TRIALS DENMARK

Report trials mattresses Denmark

1. Introduction

RetourMatras was founded in 2010. The first facility was realized in 2011 in Lelystad. After many developments and investments, the organization has now got four facilities with two production units. As a result RetourMatras now has a recycling capacity of 1.500.000 mattresses on annual basis.

With its own developed machinery RetourMatras is unique and market leader in the field of mattress recycling all over the world. RetourMatras is the only company where an automated line is used for dismantling of mattresses. The machines have been further developed in the meantime, so that one mattress can be dismantled every 50 seconds.

The extracted raw materials are mostly processed inhouse, so the materials can be brought back to their own economy. A recycling percentage (85%) is realized by making our own product rebond foam, and the chemical recycling in Lelystad which gives to opportunity to produce repolyol. Latex is also converted into bonded product for the furniture industry. The metals can be cleaned to bring back in the metal market and the textiles are made into felts of any sort.

RetourMatras possesses a ISO9001:2015 certificate and due to the collaboration with IKEA also meet all standards of IWAY standard 6. This means that people, environment and animal welfare are taken into account as much as possible in the whole process.

2. Purpose

The purpose of this report is to describe the results of the dismantling of the first Danish mattresses. Last month we received two loads of mattresses in Lelystad from three different collection facilities in Denmark: Copenhagen, Vejle and Hillerød.

In previous meetings with the Mattress Recycling Workgroup, it was agreed to see whether the Danish mattresses differ from the Dutch mattresses. This way is can be checked whether a facility in Denmark can be built in the same way as here in the Netherlands.

3. Results dismantling

In this paragraph the results will be described with the help of photos. Let's start with an overview on how many mattresses we've received of each sort of mattress. And if the mattresses can be recycled in our automated dismantling machine.

3.1 Bulky waste

Sort mattress	Amount	Average weight	Dismantled by machine
Pocket spring mattress	35	18	Yes
Foam mattress	18	13	Yes
Boxspring mattress	71	33	No
Top mattress	6	10	No

In total we received 130 mattresses in the bulky waste load. The weight of this load was: 3212 kg (pallets excluded). This means that the mattresses, including Boxspring and top mattresses, weigh around 25 kg.

3.2 Recycle station

Sort mattress	Amount	Average weight	Dismantled by machine
Pocket spring mattress	45	18	Yes
Foam mattress	36	14	Yes
Boxspring mattress	51	35	No
Top mattress	40	11	No

In total we received 172 mattresses in the second load from the recycle stations. The weight of this load was: 3516 kg (pallets excluded). The mattresses, including Boxspring and top mattresses, weigh around 21 kg each on average. Dutch mattresses weigh around 16-18 kg, so when looking at the pocket and foam mattresses only, the weight is the same. This is also the case for the bulky waste load.

Below there are photos with a description on how and whether the mattresses are recycled via machine or not.

3.3 General photos of recycling



The first picture shows how the RetourMatras employee separates the different materials recovered from the mattress. On the second photo we see the textiles piled up, which will be baled same as the foams. The foam baling is showed in the last photo.

3.4 Pocket spring mattresses



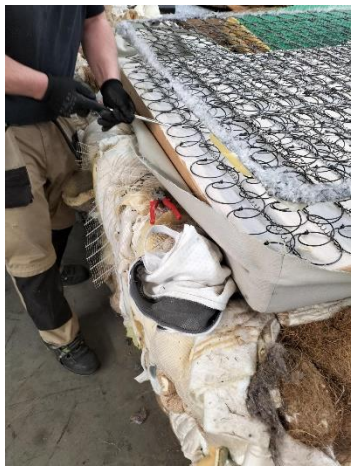
These mattresses can be processed the automated machines. In these mattresses we see no wood and metals on the outside of the mattress. The machines cut the mattresses on three sides and thereafter will peel off the textiles. After that the pocket springs are taken out by the employees and the foams continue in the automated process. The foams are cut into strips and baled after. The metals are being processed in the Etten-Leur facility in a shredding machine and separated from the plastic pocket.

3.5 Foam mattresses



Foam mattresses are the easiest mattresses to process in our machines. The same as the pocket spring mattress the mattress is cut on three sides and the textiles are peeled off mechanically. After the peeling the foams continue on the conveyor belts to the cutting machine which cuts in into strips and into the baling machine.

3.6 Boxspring mattress


On the first picture we see Boxspring mattresses with a wooden side frame. Due to the wood we are not able to process them in the automated machine. The reason for this is that the cutting saw is cutting at such high speed that this produces a lot of heat, especially when cutting into wood, so this causes fire danger. All Boxspring mattresses need to be recycled manually. Material can be reused, but economically not worthwhile, the costs are too high to dismantle the Boxspring mattress. Research and developments are necessary to develop new dismantle opportunities for decreasing the costs of Boxspring dismantling. There could be an opportunity in shredding the Boxspring and removing the wood and metal from the waste. The recyclable streams can be used by third parties.

Dismantling of the Boxspring mattress takes an average amount of time of 15 minutes per mattress. Some of the mattresses take even longer like the ones in the second photo. As you can see the employee is trying to separate the springs from the wood, but this is a very time consuming work because the springs are attached to the wood with staples. This is showed in the third picture above.

3.7 Top mattresses

The top mattresses showed on the pictures above are delivered more and more in our facilities in the Netherlands. All of these top mattresses are to flat to dismantle with the automated line. The cutting machine is not able to cut into the flat surface. This means that same as the Boxspring mattress, all of the top mattresses need to be processed manually. Most of the top mattresses contains textiles and foam on the inside, so the materials are good to use in our further process.

4. Weight different materials

Weight of Boxspring mattress

The weight of an average Boxspring mattress delivered in the first loads is 36 kg each. This is, as told before, a lot heavier than a normal mattress. The mattresses with foam or pocket springs are around 18 kg each.

Important note: the weight of these Boxspring mattresses has not been taken into account in the following paragraphs.

4.1 Bulky waste

Recyclabe?	Material	Bulky waste		%
Yes	PU	385	kg	41%
Yes	Latex	49	kg	5%
Yes	Pocket/metals	212	kg	22%
Yes	Textiles recyclable	55	kg	6%
No	Textiles non-recyclable	129	kg	14%
No	Residual waste	117	kg	12%
	Total	1024	kg	100%

As seen in the table above most of the retrieved materials can be recycled. The recycle percentage of the mattresses from the bulky waste is 74%. This percentage is lower than the recycle percentage in the Netherlands and the mattresses from recycle stations. The reason for this is the condition of the textiles, which are dirtier than textiles from the recycle stations.

4.2 Recycle station

Recyclabe?	Material	Recycle station		%
Yes	PU	532	kg	31%
Yes	Latex	116	kg	7%
Yes	Pocket/metals	497	kg	29%
Yes	Textiles recyclable	237	kg	14%
No	Textiles non-recyclable	203	kg	12%
No	Residual waste	152	kg	9%
	Total	1645	kg	100%

When looking at the mattresses from the recycle station the recycling percentage is almost the same at 80%.

4.3 Boxspring from bulky waste

In the table below you can find the composition of the Boxspring mattresses.

	Material	%	kg
Yes	Wood	56%	1300
Yes	Metals	11%	255
No	Textiles non-recyclable	6%	139
No	Waste	27%	627
	Total	100%	2322

In both loads there were a lot of Boxspring mattresses. As mentioned before, those are hard to dismantle. In the table the different materials are spread out. Most of the Boxspring mattresses contain over 50% wood. This is a recyclable stream, but costs money. The only positive stream from the Boxsprings is the metal fraction.

4.4 Boxspring from Recycle station

Recyclable?	Materiaal	%	kg
Yes	Wood	58%	1035
Yes	Metals	10%	179
No	Textiles non-recyclable	5%	89
No	Waste	27%	482
	Total	100%	1785

The other load of mattresses contained a lot of Boxspring mattresses too. The composition is on average the same as the other load. This was expected, due to the fact that Boxsprings are always built the same way. The textiles from the Boxspring mattresses are not recyclable because they are almost always sticked or stapled to the other materials. This cannot be separated. This also is the case for the PU foam in the mattresses, there is not much in them and it's to hard to separate, which means that it is waste.

4.5 Potential use foam chemical recycling

Looking at the foam in the Danish mattresses is doesn't seem to differ from the Dutch mattresses. This means that the foam can be used in the chemical recycling plant. Below is a table that shows how new PU foam can be made with the help of Polyol made from post-consumer PU foam.

Raw materials	%
Polyol out of post-consumer mattresses	40
Basic Polyol	37
Acids	13
Additive	6
Catalyst	4

4.6 Figures of totals

In this paragraph a couple of figures of the whole trial will be shown. To start the weight of the different sort of mattresses in the two loads.

	Bulky waste		%	Recycle station		%	Total	
Pocket	613	kg	19%	810	kg	23%	1423	kg
Foam	225	kg	7%	504	kg	14%	729	kg
Boxspring	2322	kg	72%	1785	kg	50%	4107	kg
Top	60	kg	2%	440	kg	13%	500	kg
Total	3219	kg	100%	3539	kg	100%	6758	kg

Recyclability of mattresses which can be dismantled via de automated dismantling line

Recycle% Bulky waste	74%
Recycle% recycle station	80%

What becomes clear in this section is that the mattresses retrieved from bulky waste are less recyclable than the mattresses from the recycle station. As mentioned before the reason for this is the textiles which are more contaminated.

Recyclability of Boxspring mattresses

Recycle% Boxspring bulky waste	67%
Recycle% Boxspring recycle station	68%

The Boxspring mattress are recyclable in a way, but not as well as the other mattresses. Add the amount of time needed to recycle them in the way we can recycle them at this moment and the conclusion will be that this way of recycling is not logical.

Below are the figures of all incoming mattresses and the weights of the recovered materials (mass balance)

Material	Bulky waste		Recycle station		Total	
PU	385	kg	532	kg	917	kg
Latex	49	kg	116	kg	165	kg
Metal	467	kg	676	kg	1143	kg
Textiles recyclable	55	kg	237	kg	292	kg
Textiles non-recyclable	268	kg	292	kg	561	kg
Wood	1300	kg	1035	kg	2336	kg
Residual waste	744	kg	634	kg	1378	kg
Total	3269	kg	3522	kg	6791	kg

It has become clear that the incoming kilograms match the outgoing stream. The differences in weight are caused by the weighing of the outcome. We took 20 mattresses as samples and weighed all the dismantled materials separately. The average of each of these streams was multiplied by the total amount of mattresses, which gave this outcome.

The residual waste contains the glued/stapled material which can't be recycled. When the textiles are glued, sticked or stapled to the other materials, it's to contaminated to recycle it as textiles. The foam that is attached to it is also to contaminated with textiles to recycle the foams. In the Netherlands we see around 10% of residual waste and as all the figures state it is the same in Denmark.

Recyclability of all mattresses (including Boxspring mattresses)

Recycle% Bulky waste	69%
Recycle% recycle station	74%

These numbers are significantly lower than the normal mattresses and the mattresses we recycle in the Netherlands. The reason is clearly recycling Boxspring mattresses. Furthermore we see that the bulky waste is less recyclable, as mentioned before the reason is the dirty textiles. The load only contains 55 kg of clean textiles, which causes the recycling percentage to drop 6%.

5. Conclusion

The purpose of these trials was to check whether Danish mattresses differ from the Dutch mattresses. The only conclusion is that the difference in mattresses is within the Boxspring mattresses. The ones from Denmark with the wood attached to the rest of the mattress are not common in the Netherlands. At this moment these Boxsprings are not recycled by RetourMatras.

These Boxspring mattresses cost almost 15 minutes to dismantle, which is long compared to the automated dismantling unit. The machine can dismantle a mattress every 50 seconds. The recycling percentage of those Boxspring mattresses is also lower than the average mattress. Furthermore, the materials recovered from these mattresses are mostly a negative stream. This means that the costs of recycling them in the way we do at this time is not efficient. At this moment, with the experience RetourMatras has, it is not an good idea to collect the Boxspring mattresses together with the other mattresses.

Besides this, there are no big differences between the both countries. When looking at the percentages of retrieved material this matches the division seen in the Netherlands. It is actually almost exactly the same.

To conclude: the mattresses (Boxspring excluded) are alike in the both countries and could be recycled in the same way as in the facility of RetourMatras in the Netherlands.

What does this mean for a possible opening of a facility in Denmark? It seems feasible to expand the RetourMatras method in combination with the city of Copenhagen in Denmark to achieve recycle goals.