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BELGISCH VERPAKKINGSINSTITUUT INSTITUT BELGE DE L'EMBALLAGE

# The influence of cold temperatures on FIBC's

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### Question

IBE-BVI received the following question of one of his clients/members who was closing a deal:

What is the behavior of woven PP and what are the risks of using FIBC's in extremely cold environments?

The location from where this questions was raised (Canada) has only 3 months a year positive values on the temperature level, and the end user would like to store them outside.



### **Thoughts?**

 Is there already knowledge about the behavior of PP materials in function of temperature?

> Yes!

• Is it useful in this case?

#### ➢ Not really....

because this information is related to the material it is very difficult to find a correct correlation between the behavior of the isolated material and the final behavior of a complete packaging.

=> Solution: starting a new study on the complete packaging!!



### Scoop of the project:

- 1. Set up a temperature range to be studied.
- 2. Set up a test procedure to collect data.
- 3. Determination of the samples to be used in these tests.
- 4. Physical testing.
- 5. Evaluation of the gathered data and end conclusion.



### 1. Set up of a temperature range to be studied:





#### 1. Set up a temperature range to be studied:

After evaluation of different sources (world temperature measurements) it was considered that a temperture of -40°C would be sufficiently as low level.

Sheduled temperatures for this study:

```
+20,0,-20,-40°C
```



#### 2. Set up a test procedure to collect data.

- Conditioning of filled samples at different temperatures for 2 until 4 days.
- Top lift test (\*) of (at least) 2 samples per temperature

\* Top lift tests of 1 cycle up to rupture/break in order to keep the temperature as close as possible to the aimed temperature. This method can deliver data that can be compared afterwards.





## 3. Determination of the samples to be used in these tests

IBE-BVI in collabortion with *Louis Blockx Belgium* decided in a first stadium to use very standard FIBC's, but produced with high care in order to have the lowest possible variations in results.

- 4 loops
- U panel
- Non coated fabric
- Without emptying spout



#### Samples used for tests:





### 4. Physical tests

To avoid variation in temperature during the test it was decided to keep the testing time as short as possible:

- Using the normal Toplift equipment with normal testing speed and filling product
- Not using the precycling top loading
- Going immediately until breaking force



## 4. Physical tests +20°C result



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#### Test results at +20°C





### 4. Physical tests -40°C result



#### Test results at -40°C





## 5. Evaluation of the gathered data and end conclusion

- Reached values at break:
  - Difference of 76 kg less at -40°C on the average of the tested bags.

Points of rupture:

Exactly the same!!



#### 5. Evaluation of the gathered data and end conclusion



20°C

-40°C



#### Conclusion:

There is very little (-1%) / no effect of negative temperature on the performance of complete FIBC's on toplift level!

So all existing testprocedures are sufficient to cover and prove the performance of FIBC's!

BUT.....





Because of the many years of experience of IBE-BVI in the testing of packagings in general we asked ourself the following question:

Are there really no effects at all?? Maybe at other temperature ranges??





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### The influence of <u>higher</u> temperatures on FIBC's

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#### Physical tests +20°C



#### Test results at +20°C





#### Physical tests +30°C



#### Test results at +30°C





#### Physical tests +40°C



#### Test results at +40°C

Test result at +40°C:

# FIBC's: 2

Average force: 6775 kg

Breaking of 1 loop + severe opening of the body fabric at the returns of the loops (but less than at lower temperatures) + opening of the side stiches.





#### Physical tests +55°C







#### Test results at +55°C

Test result at +55°C:

# FIBC's: 3

Average force: 6230 kg

Body fabric tears open at the return of one loop + opening of the side stiches.





+20°C

+30°C



+40°C

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+55°C

#### Relation between temperature and force at break:





### Final evaluation of the gathered data

- Reached values at break:
  - There is a significant lowering of the overall performance of FIBC's at higher temperature.

- Points of rupture:
  - The detoration points are changing with the temperature.
  - Between 40°C and 50°C the woven material starts to be influenced by softening/becomes more elastic.



#### **Conclusion:**

There is an important effect of higher temperature on the performance of complete FIBC's!

Around 17% lower performance results, what brings the safetyfactor of a 5/1 back to almost a 4/1.....



#### **Conclusion:**

#### Are still all existing testprocedures sufficient to prove the overal performance of FIBC's ????





- Inside a vessel/container whilst loading and unloading the temperatures are known to raise up to very high values!
- In very hot countries temperatures can reach upto 50°C during summer!?



## Future plans of IBE-BVI to continue this study.

- Continuing tests with higher temperatures + trying to find the critical temperature + on varities of woven fabrics also incorporating other tests as described in UN.
- Integrating the combined effects of UV exposure and temperature on complete FIBC's
- What is the influence of UV degradation on SF?
- What about the SF if the PP-material fullfills the 50% remaining stress level after UV exposure as foreseen in the standerd ISO 21898?



## Future plans of IBE-BVI to continue this study.

- Starting up an european or even international study on previous items with a broader range of FIBC's.
- Searching out the influence on the SF of outside exposures and artificial exposed FIBC's.
- Using these results for supporting/creation a new set of requirements/standard.



#### Thank you for your attention!

#### Thanks



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### Thanks!!

#### Thank you all for your attention and I wish you all a pleasant continuation of this world conference!

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ISO 17025 Nr. 282-TEST

#### Founded in 1954



### IBE – BVI group



Belgian Packaging Institute (BPI) Institut Belge de l'Emballage (IBE) Belgisch Verpakkingsinstituut (BVI)

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