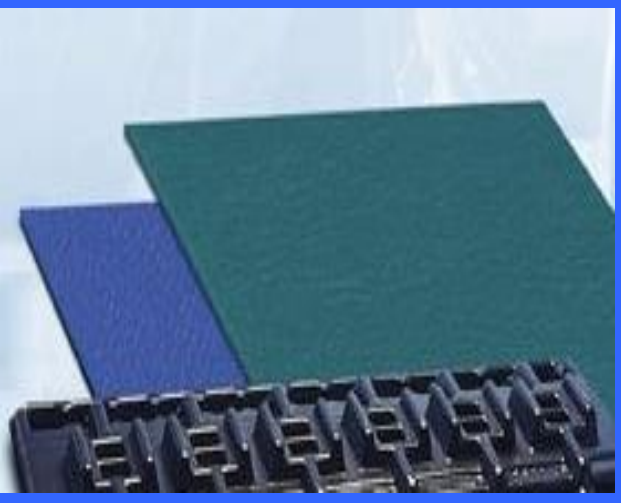
Industrieverband
Halbzeuge und Konsumprodukte
aus Kunststoff e.V.



pro-K Fachgruppe
Thermoplastische Platten

Statement

on influence of regrind on properties of sheet material for thermoforming

Stand: April 2011

Introduction

The member companies of the section Thermoplastic Sheets of the registered Pro-K Industry Association on Plastic Industrial and Consumer Goods have issued this general statement to create awareness regarding the influence of regrind material on the properties of sheet material for thermoforming and to point out the potential risks if regrind is used in sheet material for thermoforming.

Picture credits (front-page): © MITRAS Materials GmbH

Important note:

This elaboration is only intended to provide information. All information contained in this document was issued to the best knowledge and belief. However, pro-K does not take any responsibility for the correctness or the completeness of the information. Therefore, every reader has to assure himself that the information applies to his purpose and suits it. Manufacturer and client can individually agree on values deviating from the technical leaflet.

Version: April 2011

Fachgruppe Thermoplastische Platten
The Fachgruppe Thermoplastische Platten is a Fachgruppe of pro-K Industrieverband Halbzeuge und Konsumprodukte aus Kunststoff e.V., Städelstraße 10, D-60596 Frankfurt am Main; Tel.: 069 - 2 71 05-31; Fax 069 - 23 98 37;
E-Mail: info@pro-kunststoff.de; www.pro-kunststoff.de

Industrieverband
Halbzeuge und Konsumprodukte
aus Kunststoff e.V.

Industrieverband Halbzeuge und Konsumprodukte aus Kunststoff e.V.

Index

1. Influence of regrind on properties of sheet material for thermoforming

(Potential risks of using regrind in sheet material for thermoforming)

Regrind is used in the production of semi-finished plastic goods for economic and ecological reasons (recycling). One source for such regrind is cut-off material when sheets are trimmed after thermoforming. Another source are regrind dealers that offer regrind material in various qualities. Regrind material is used either in combination with virgin polymer or for a 100% regrind product. This statement addresses possible changes in product quality when regrind is used for thermoplastic sheets.

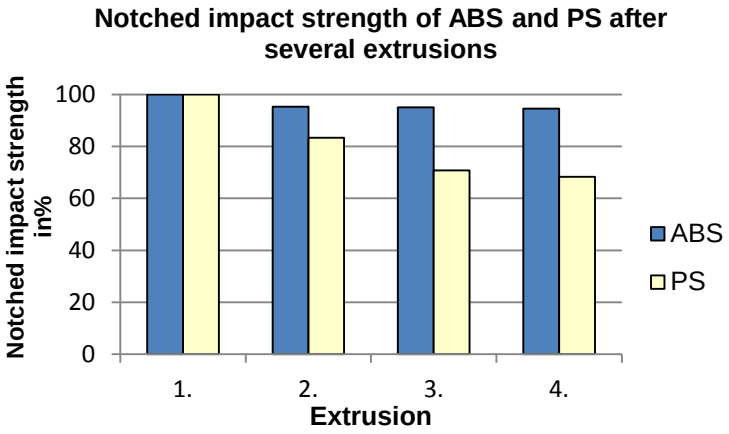
Intensive tests have shown that plastic materials show a considerable loss of quality after several extrusion cycles.

The table below demonstrates the influence of several extrusions runs on notched impact strength of ABS and Polystyrol.

Table 1: Notched impact strength of ABS and PS after several extrusion runs in percentage of initial value	ABS (%)	PS (%)
After 1. Extrusion (100% virgin material)	100	100%
After 2. Extrusion (100% regrind material)	95,3	83,3
After 3. Extrusion (100% regrind material)	95,1	70,8
After 4. Extrusion (100% regrind material)	94,6	68,3

Note: This is an example based on specific polymer grades of ABS and PS. Depending on the polymer grade and type the decrease of mechanical properties can differ.

The results show that pressure and temperature during extrusion lead to a higher loss of mechanical quality with PS compared to ABS. While ABS only shows a small decrease of notched impact strength, the PS values show a drastic drop.



Under high temperatures all thermoplastic materials show a degradation of their molecule structure which means that de-polymerisation takes place. While this degradation process may vary according to raw material grade or type, the result is a reduced molecule size that causes the loss of mechanic properties. Depending on the type of application it is advisable not to use 100% regrind during extrusion but to combine regrind with virgin material.

For many applications coextrusion of several layers is the rule. In the case of coextrusion regrind will typically be used for or added to a specific layer. This may lead to incompatible polymer combinations.

The example of an ABS/ASA coextrusion (ABS layer 80% of sheet, ASA layer 20% of sheet) shows that if virgin ABS is replaced by 100% ABS/ASA regrind the notched impact strength drops by almost 20%. This is even more remarkable since ABS and ASA are chemically very similar polymers.

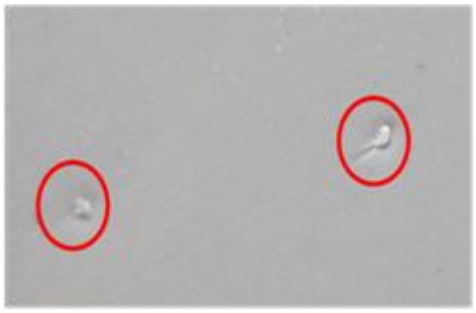
Table 2: Notched impact strength of ABS/ASA coextruded sheet		Notched impact strength (%)
1st extrusion run: top layer ASA (100% virgin) carrier layer ABS (100% virgin)	 20% of sheet weight 80% of sheet weight	100
2nd extrusion run: top layer ASA (100% virgin) carrier layer ABS/ASA (100% regrind of 1. Extrusion run)	 20% of sheet weight 80% of sheet weight	81,2

Therefore it is advisable to use regrind in combination with virgin material. However, if regrind has been through an extrusion process for several times the concentration of the top layer material will rise in the carrier layer. In the above example a 50% addition of regrind in the carrier layer will result in a 10% concentration of ASA in this layer after the 2nd extrusion run. If regrind of regrind is added to the carrier layer the ASA concentration will rise to 18.8% after the 4th extrusion cycle.

In the case of polymers with a very different chemical structure a combination (e.g. of ABS with PMMA or TPE) will result in an even further loss of original qualities.

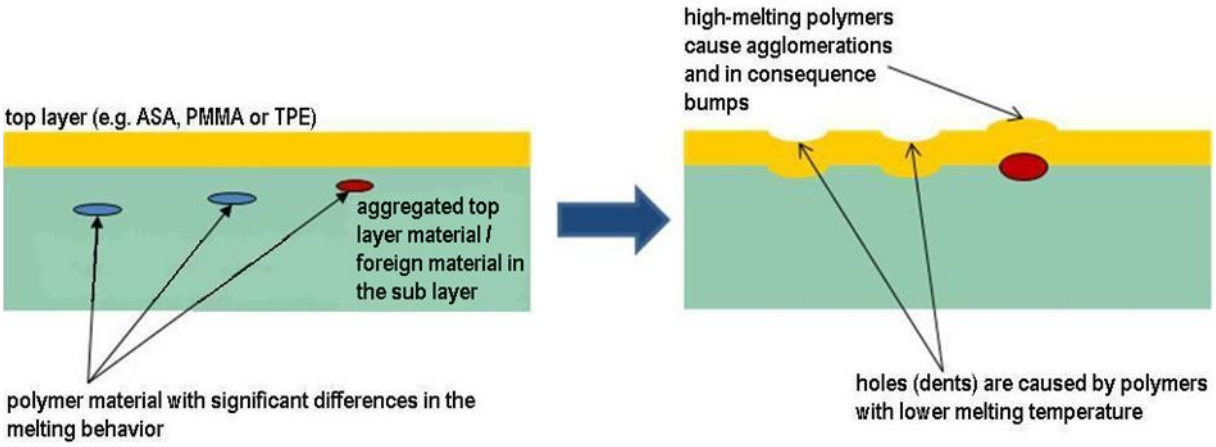
While the examples above demonstrated the loss of mechanical properties by examining the loss of notched impact strength, a combination of polymers with different chemical structure during extrusion will not only result in a loss of mechanical qualities.

The example below shows a loss of surface quality:



Significant differences in the melt behaviour of polymers combined during coextrusion will lead to sheets with bad surface quality.

While polymers with a lower melt temperature will cause holes on the coextruded sheet surface, polymers with a higher melt temperature will cause agglomerations and as a consequence bumps on the coextruded surface.



2. Summary

In general, the use of regrind in the production of sheets for thermoforming can lead to losses in product quality. An exact predication of the quality loss is not possible since there are many parameters that have an influence on the properties of extruded sheet materials.

This does not mean that the use of regrind shall be avoided. However, the use of regrind has to be carefully planned and inspected:

- A clear specification of the sheet material has to be set and communicated. This allows to determine if and under which circumstances regrind can have an influence on specified sheet properties. It also has to be understood that by using regrind a constant quality level cannot be achieved.

- Loss of quality will depend strongly on the type and combination of the polymers involved.

- In order to keep quality fluctuations to a minimum when using regrind:

    - Use regrind from virgin material only.

    - Thermoformers should collect scraps (after trimming) on a product specific basis.

    - Limit the amount of regrind added.

    - Avoid regrind from unreliable suppliers especially when regrind is scarce.