SIS / SBS BASED HMPSA FOR OPP PACKAGING TAPES

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Introduction

Packaging tape is probably the largest volume application for pressure sensitive adhesives. Bioriented polypropylene (BOPP) film is the backing of choice with a share of about 70% in Europe and more than 90% in US and Asia. Of the different adhesives used with BOPP films, block copolymer based hot melt adhesives (HMPSA) are most popular in US while having a share of about 30% in Europe with fast growing tendency. These HMPSAs are generally based on styrene - isoprene block copolymers (SIS) because of their superior performance over time. One draw back is that, they are relatively expensive when compared to adhesives based on other block copolymers such as styrene - butadiene block copolymers (SBS). Another draw back is the sometimes limited availability of SIS block copolymers as it happened a few years ago.

We have tried to develop SBS based HMPSA compositions over several years, without success. While the initial adhesive properties were acceptable, the aged properties declined rapidly when compared to SIS based PSA’s. Furthermore, the required adhesion to cardboard, particularly recycled cardboard was not sufficiently achieved. We then developed a SIS/SBS based HMPSA introducing a newly developed SBS, tailored to achieve the desired properties for an OPP packaging tape. The adhesive composition also uses 2 different tackifiers, one compatible with SIS and one compatible with SBS. It is apparent that, using SBS as a key formulation ingredient, will reduce the PSA cost considerably. It is within this respect that we would like to discuss the SIS/SBS HMPSA development in more detail

Raw materials for formulation development

Table 1 summarizes the key properties of the SBS (DPX 579) developed for the discussed SIS/SBS adhesive system. The target was to develop a block copolymer, which is softer than typically used SBS types having a styrene content of about 30%. We wanted to achieve a composition, which provides in a 1:1 blend with a pure triblock SIS (Vector 4511) the basis for a high performance HMPSA for OPP tapes, comparable to SIS based HMPSA. We tried obviously to optimize the styrene content as well as the styrene block molecular weight in this respect. It has been found that the adhesive system reacts very sensitive to changes in styrene content i.e. shear drops significantly at too low styrene levels, vice versa, the tack and wetting behaviour deteriorated at higher styrene levels.
As one can see from present table, we ended up with a styrene content of 25%, which provided the best compromise in terms of shear and wetting on cardboard. It is worth highlighting that this SBS is a pure triblock block copolymer, which has advantages over diblock containing products as we will discuss later in this paper.

Obviously the tackifier resins used in such an adhesive composition play an important role too as far as well balanced PSA properties are concerned. The principle for the selection of the tackifier resins was to use a SIS compatible resin and a SBS compatible resin. As known by skilled people, SBS compatible hydrocarbon tackifiers need a relatively high aromatic content which has a detrimental effect on the shear of block copolymer based PSAs. Table 2 lists the properties of the tackifier resins, which were used for the development of the SIS/SBS HMPSA. As SIS tackifier a low aromatic modified C5 resin as widely used as single tackifier for SIS based adhesives was chosen (Escorez(R) 2211). The SBS tackifier is a medium aromatic modified C5 resin generally used as single SBS tackifier (ECR 373).

**HMPSA blend preparation and coating**

We use in our labs 2 types of z-blade mixers as well as 2 types of coating equipment. For screening work we use small 250 ml mixers which are electrically heated. Coating is carried out onto PET film on a 100 mm wide Acumeter HM coater. This system is easy to use and requires only small quantities of raw material.

In an advanced step we use a 4 kg z-blade mixer which is equipped with a discharge screw. This discharge screw is at the same time a very efficient mixing tool by pushing the PSA compound continuously towards the mixing blades during the blending step. Coating of the HMPSA is conducted on a 300 mm wide Nordson HM coater equipped with a die with rotating bar. In this case OPP is being used as backing to make genuine OPP packaging tapes. Table 3 shows the blending procedures used with the different mixers.

With both mixers we obtained perfectly homogeneous HMPSA blends in any SIS/SBS ratio.

Figure 1 displays pictures of our mixing and coating devices.

**Continuous Twin Screw Extruder Mixing**

In order to simulate typical state of the art mixing technology, we ran numerous experiments at Maris in Italy, one of the major twin screw compounding extruder manufacturers in Europe. For the trials a 30 mm extruder with a length of 54d has been used. SIS and SBS has been fed simultaneously into the first port, the resins were fed into port 3 and 4 and the oil at the end. Feeding was realized by means of gravimetric weighing systems.

For the resin addition the extruder was equipped with cooled side feeding to avoid heat transfer to the resin hopper. This is state of the art also for commercial Maris extruders. The oil was fed with a positive displacement gear pump.
Figure 2 shows the torque development during mixing relative to the percentage of SBS used in the formulation.

From the data it is obvious that there is very little increase in torque with increasing the SBS ratio in the blend. This finding is contrary to rumors frequently spread in the industry that SBS crosslinks during compounding and eventually blocks the extruder.

We can also see that, even without oil in the formulation, the torque does not change relative to the formulation with 10 phr oil.

The temperature profile of the extruder can be seen in figure 3. At each feeding point of block copolymer and resin the temperature has been set at room temperature to avoid melting of products at the product inlet. If the formulation contains 2 resins in different amounts, the resin with the smaller quantity should be fed first. This is advised to maintain the torque at a high enough level for a good blending.

The temperature of the HMPSA at the extruder outlet is about 25 °C above the second half extruder temperature.

The HMPSA was poured into siliconized boxes to cool down and be prepared for shipment to our labs for coating onto OPP film.

**SBS Stability during HM Processing**

During both, the z-blade mixing as well as the extruder mixing, no gel formation of the SBS occurred. The gel formation in SBS block copolymers during HM processing is a major concern people in the industry generally have.

We believe that the process to make Vector pure triblock SBS provides a very stable product, particularly as far as heat and shear stability is concerned.

Also after heating the HMPSA up again to a temperature of 175 °C for coating, no gel formation took place. This additional heat history does not happen in continuous industrial operations, which means that, the danger of gel formation there is even less.

Based on our findings, the fear of getting gel formation or even worth, extruder blocking during mixing, is baseless at least when using Vector (R) pure triblock SBS.

**Statistical experimental formulation design**

A full factorial design with 4 variables has been performed. 18 formulations were prepared in 250 ml z-blade mixers and consequently coated onto 36 micron PET film for testing. The coating was done from HM on a Acumeter lab coating machine.

Variables for the design were SBS, SIS, SBS tackifier and SIS tackifier. The oil content was kept constant at 10 parts for all formulations.

Table 4 shows the numerical part of the statistics, listing basically all formulations which have been performed to run the design. This table is only added for completeness and will not be further discussed in the context of this paper.
In Table 5 the PSA properties are listed which have been tested to assess the performance of the PSA blends. All tests are based on AFERA, PSTC or FINAT Test Methods. The 2 most important properties concerning OPP packaging tape performance, are tack and shear on cardboard at 40 °C. The peel adhesion measured on steel gives only very little indication about the adhesion to cardboard since this is depending more on wetting and cohesion which in turn influences the shear properties.

Another important attribute of a HMPSA for OPP packaging tapes is the melt viscosity. Typically HM OPP tape coating lines run at high speed, actually up to 600 m/min or 1950 ft/min. This high speed requires a HMPSA with a relatively low melt viscosity at coating temperature to obtain a smooth, line free coating surface.

For state of the art HM coaters equipped with a coating die with an integrated rotating bar, the viscosity should preferably be below 100 Pa.s.

Discussion of Statistical Design Results

In the course of this paper I will limit the discussion to the most important OPP Packaging Tape attributes namely, Loop Tack, Ball Tack and Shear on Cardboard at 40 °C. Melt viscosity at 175 °C, due to its importance for the coating process, will be discussed as well.

The first set of data (Figures 4 - 7) is based on 100 parts of rubber containing 50 parts of each, SBS and SIS. In this case the listed numbers on the contour graphs can be considered as resin phr, which makes the understanding easier.

The Loop Tack is a measurement providing a good idea about wetting and adhesion of a PSA on any surface on which it is used. For the present study we performed it on a standard stainless steel surface on which one can expect reliable and easily repeatable values. In Figure 4 we can see the dependence of the loop tack from the total resin content and more specifically from the SBS tackifier (ECR 373) content. This is due to the sensitivity of the SBS on the type of tackifier being used. There is no real minimum or maximum target for the loop tack since it depends vastly on the peel adhesion.

The Ball Tack, Figure 5, on the other hand, seems to depend mainly on the amount of Escorez 2211, the fraction of ECR 373 having a minor influence. This is not really in contrast to the loop tack findings, which we have discussed before since the Ball tack improves in the direction of reducing the Escorez 2211 fraction, which in turn means, increasing the ECR 373 influence.

When comparing the visual aspect of the Loop Tack and Ball Tack design, Figure 6, the shape of the contour lines looks completely different. A closer look teaches us that, in both cases we find the best performance at low SIS tackifier content and high SBS tackifier content in the formulation.

Unfortunately, designing PSA formulations is not a straight forward task, the incompatibility between tack and shear performance is well known in the art.

As one could expect, we found this controversial behaviour back in this design study (Figure 7). The lower the resin content the better the shear with the higher impact coming from ECR 373.
This is in perfect contradiction to what we found for the ball tack and loop tack design. The more negative impact of ECR 373 stems from its higher aromatic content which is needed for good SBS compatibility but simultaneously softens the styrene domains and thus reduces the shear.

Comparing the HMPSA blend viscosity with the shear on cardboard at 40 °C, one finds an amazing similarity. The 2 designs look like mirror images. Normally we expect this similarity between the shear adhesion failure temperature (SAFT) and the melt viscosity but not with the 40 °C shear on cardboard. One would certainly expect the same trend for those two features but not this detailed similarity. Notwithstanding these results, the contradiction here is that, we look for high shear and low melt viscosity.

The second set of design data (Figures 8 and 9) is based on a fixed resin ratio showing the 2 block copolymers as variables. For this purpose we fixed the resins at 80 parts Escorez 2211 and 30 parts ECR 373. This ratio has been chosen based on design results and the desire to minimize the SBS tackifier for its obvious detrimental impact on shear.

Since it is well known that, it is very difficult to obtain well balanced PSA properties with SBS, there is no surprise to find Loop Tack values which depend mostly on the amount of SIS in the formulation, showing a maximum at a minimum SBS share (Figure 8). For the Ball tack we find a very similar design with the same conclusion as for the Loop Tack.

Figure 9 shows the comparison of shear on cardboard and melt viscosity. The design confirms what we found in the resin variable design already that, the highest shear is being obtained at the highest block copolymer ratio or in other words, at the lowest resin content. At the same time the design shows also that, the major impact for the shear stems from the SIS. This was to expect since SIS will always allow formulation of superior PSA performance over SBS based systems as far tapes are concerned.

The melt viscosity follows pretty much the pattern of the shear again. The key difference is that there is no particular impact of one or the other block copolymer.

The software allows to calculate the optimal HMPSA blend composition based on desirability of one or the other PSA property. The example in Figure 10 is based on a maximum shear at 40 °C desirability within the given max and min boundaries for each formulation ingredient. We can see the much steeper lines for both block copolymers than for the resin, meaning that the impact of the rubbers on shear is much more pronounced than the one of the resins. The best formulation composition in this case is given at the bottom of the graphs.

**DMA Analysis of Selected Formulations**

DMA, this is well known, is an excellent tool to better understand and also to predict rubber/resin/plasticiser interactions of a pressure sensitive adhesive. There is one weakness, however, DMA cannot predict the adhesion of a PSA to difficult surfaces. It can only provide a number of supporting data on the intrinsic PSA properties but not on surface phenomena as present between a PSA and a contact surface.
Following formulations were selected:
Vector 4511/DPX 579/Escorez 2211/ECR 373/Oil/AO
Blend 1: 50/50/80/30/10/1
Blend 2: 50/50/73/27/5/1
Blend 3: 50/50/80/30/5/1

Vector 4511/Escorez 2203/Oil/AO
Blend 4: 100/110/10/1

The DMA graph (Figure 11) shows the comparison of a standard SIS based HMPSA, as it is currently widely used in the industry, with 3 SIS/SBS based formulations. Comparing Blend 1 and 4, two formulations with the same rubber/resin/oil ratio, it is noticeable that the plateau of the storage modulus is at the same level. The plateau of the SIS/SBS based PSA is a little shorter than the SIS one but in the most frequently used temperature range for packaging tapes (ca 20 - 60 °C), there is very little difference. The Tg in both cases is at -5 °C, ensuring good tack at low temperatures.

Blends 2 and 3, both SIS/SBS based, contain less resin and oil than Blends 1 and 4, resulting in a higher plateau modulus over the entire temperature range. This increase in modulus should result in poorer wetting properties, which we can only partially see when measuring PSA properties. The Ball tack value in both cases is slightly higher but at the same time the shear on cardboard at 40 °C is higher too. The higher shear suggests that, the wetting is sufficiently good. It is needless to say that the shear on cardboard at room temperature is for all discussed formulations beyond 6000 minutes. The drawback of the lower resin and oil content is the higher cost, which may make this composition less attractive.

Based on the PSA properties as well as the findings of the DMA analysis we have chosen Blend 1 for conducting a commercial tape plant trial.

**SIS/SBS HMPSA Performance**

While all the experimental design results are derived from HM coating onto PET film, we tested selected formulations, coated onto OPP film. There is a distinctive difference in PSA properties between PET film coated material and OPP coated material. This difference is especially pronounced in the case of shear measurements on cardboard, at room temperature or elevated temperature, an attribute which is key for packaging tape performance. The main reason for this difference is based on the film stability. In most cases a shear failure on cardboard begins with the tape lifting slightly at one edge and starting from this point the tape shears off in a given time. OPP film based tapes develop wrinkles over the contact area with the cardboard once one edge start to lift. Those wrinkles reduce the contact area which makes the shear failing faster. In case of PET film, because of the inherent film stability, those wrinkles do not occur and therefore the contact area of the tape with the cardboard remains stable for a longer time.
Figure 12 displays the performance of OPP tapes made with our pilot operations. As mentioned earlier in the paper, the HMPSA blend has been made in a 4 liter z-blade mixer with discharge screw. The coating onto 28 micron OPP film was conducted on a 300 mm wide Nordson coater using a slot die with rotating bar.

Two formulations with the best balanced properties were selected from the experimental design. Formulation 1 is based on a 50/50 blend of SIS and SBS while formulation 2 uses a higher share of SBS, which requires also a higher share of SBS tackifier.

As far as the PSA properties are concerned, both formulations show very similar performance, the peel adhesion and loop tack being lower for formulation 2 with the higher SBS share. Surprisingly the shear on cardboard at 40 °C happens to be practically the same in both cases. Remarkable is the big difference in shear to the PET film based tape samples, we find similar differences also for pure SIS based tapes.

As expected, the standard SIS based HMPSA shows higher peel and loop tack, both are not really important for box closure performance. Ball Tack is slightly better for the SIS based formulation, but shear on cardboard in this case is lower which is surprising. The melt viscosity for all blends is low enough to allow high speed coating.

The melt viscosity is the same in both cases, it is at a comfortably low level for high speed coating. When comparing the melt viscosity with the values of the experimental design, it can be noticed that the present values are lower than the design ones. The key reason for that is the stronger block copolymer degradation in the big mixer due to the high shear generated by the discharge screw. This has of course also a negative impact on the shear performance.

**Commercial Plant Coating Trial (Figure 13)**

In order to prove the commercial scale validity of the SIS/SBS concept, a coating trial has been conducted on a large HMPSA tape production line.

**Operation**
- State of the art HMPSA coating line, > 1.6 meter wide, max. speed > 500 m/min (1520 ft/min)
- Integrated Maris twin screw extruder with continuous gravimetric feeding
- Inline release coating

**Extruder Mixing**
- SIS and SBS feeding in first port
- Temperatures: 30 - 190 °C
- HMPSA temperature at outlet: 175 °C
Coating
- Slot die with rotating bar
- Coating Temperature: 175 °C
- Coating onto OPP film, 25 micron
- Coating weight: 18g/m²
- Coating Speed: 200 m/min (610 ft/min)

The tape performance is shown in Figure 14 in comparison with a typical commercial SIS based OPP tape. As expected, the shear performance of the SIS/SBS based tape is somewhat lower when compared to the pure SIS based OPP tape. On the other hand it needs to be said that, the 421 minutes shear value is in a range we frequently find on the market. A box closure test on highly recycled cardboard at 40 °C confirmed the good performance of the tape as far as practical use is concerned.

Summary and Conclusion

A SIS/SBS system based HMPSA for the coating of OPP tapes has been developed providing a high performance packaging tape. We have shown that the use of a tailored, pure triblock SBS in combination with SIS is a valid option to reduce cost and become less dependent on limited SIS supply.

The general suspicion that SBS in HMPSA systems develops gels or even blocks extruders could be dispelled based on extruder mixing experiments as well as plant production tests.

Work is under way at ExxonMobil Chemical to reduce the number of formulation ingredients without adversely affecting the tape performance discussed in this paper.

We are confident that this development will initiate a break through for the utilization of SBS in OPP Packaging Tape HMPSA.

Acknowledgement

The author would like to thank Eddy Swiggers for his dedicated laboratory work to generate the large number of data needed for this project.
SIS /SBS based HMPSA for
OPP Packaging Tapes

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European Technology Center
## SIS/SBS based HMPSA for OPP Packaging Tapes

### Block Copolymer Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>DPX-579</th>
<th>Vector 4511</th>
<th>Vector 4111</th>
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<tr>
<td>Type</td>
<td>Linear SBS</td>
<td>Linear SIS</td>
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<tr>
<td>% Styrene</td>
<td>25</td>
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<tr>
<td>% Diblock</td>
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<tr>
<td>MFR</td>
<td>9</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>Tensile Strength MPa</td>
<td>&gt; 25</td>
<td>27.5</td>
<td>27.5</td>
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<tr>
<td>% Elongation</td>
<td>&gt; 800</td>
<td>1200</td>
<td>1200</td>
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<tr>
<td>Shore A Hardness</td>
<td>~ 66</td>
<td>~ 40</td>
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## Properties of Escorez 2211 and ECR-373

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<th>Resin</th>
<th>Softening Point R+B (°C)</th>
<th>Molecular Weight (GPC)</th>
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<tr>
<td>Escorez®2211</td>
<td>92</td>
<td>1060</td>
<td>C5/C9 Low C9</td>
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<tr>
<td>ECR-373</td>
<td>89</td>
<td>800</td>
<td>C5/C9 Med. C9</td>
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</table>

|            |                      |
| Escorez 2211 | SIS Tackifier |
| ECR-373     | SBS Tackifier    |
SIS/SBS based HMPSA for OPP Packaging Tapes

Table 3

**HMPSA Blend Preparation and Coating**

- **Lab Procedure**
  - 250 ml z-blade mixer
  - mixing temperature 150°C
  - mixing time: 70 minutes
  - obtain homogeneous, gel free HM blend
  - coating with 100 mm Acumeter HM coater onto 36 micron PET

- **Pilot Procedure**
  - 4 l z-blade mixer with discharge screw
  - discharge screw used as additional mixing element
  - mixing temperature: 150°C
  - mixing time: 60 minutes
  - obtain homogeneous, gel free HM blend
  - coating with 300 mm Meltex HM coater onto 28 micron OPP
SIS/SBS based HMPSA for OPP Packaging Tapes

Lab and Pilot Mixing and Coating Equipment

Meltex Pilot Coater

Acumeter Lab Coater

4 I Pilot Mixer with discharge screw

250 ml Lab Mixer
SIS/SBS based HMPSA for OPP Packaging Tapes

**Torque development of extruder during mixing**

Formulation: SIS / SBS 100, Resin 110, Oil 10
Screw Speed: 300 - 311 rpm
Max. Torque: 110 Nm = 100 %
SIS/SBS based HMPSA for OPP Packaging Tapes

**Temperature profile of extruder**

![Graph showing temperature profile](image)

- **SIS / SBS**
- **Resin 1**
- **Resin 2**
- **Oil**
- Screw speed: 300 rpm
- HMPSA output: 15 kg / h

**Zone**

HMPSA temperature at outlet: 195°C
## PSA Test Methods for Properties Assessment

<table>
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<tr>
<th>Test Method</th>
<th>Description</th>
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<td>180° peel adhesion (N/10 mm)</td>
<td>PSTC 1 mod.</td>
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<td>(steel)</td>
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<tr>
<td>Loop tack (N/25 mm)</td>
<td>Finat TM 9 mod.</td>
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<tr>
<td>(steel)</td>
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<tr>
<td>Ball tack (cm)</td>
<td>PSTC 6</td>
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<td>Shear on cardboard @ RT (minutes)</td>
<td>PSTC 7 mod.</td>
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<td>12.5 mm * 25 mm - 1 kg</td>
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<tr>
<td>Shear on cardboard @ 40°C (minutes)</td>
<td>PSTC 7 mod.</td>
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<td>12.5 mm * 25 mm - 1 kg</td>
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<tr>
<td>SAFT (°C)</td>
<td>Exxon method</td>
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<tr>
<td>12.5 mm * 25 mm - 0.5 kg (steel)</td>
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<tr>
<td>Blend viscosity @ 175°C (cps)</td>
<td>ASTM mod.</td>
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</table>
SIS/SBS based HMPSA for OPP Packaging Tapes

Loop Tack (N/25mm)

E-2211 / ECR-373 in V 4511 / DPX 579 50 / 50

Figure 4
Figure 5

SIS/SBS based HMSA for OPP Packaging Tapes

E-2211 / ECR-373 in V4511 / DPX 579 50 / 50
Rolling Ball Tack (cm)

ECR-373

3.3 3.6 3.9 4.3 4.6 4.9 5.3 5.6 5.9 6.3 above
SIS/SBS based HMPSA for OPP Packaging Tapes

Figure 6

E-2211 / ECR-373 in V 4511 / DPX 579 50 / 50

ROLLING BALL TACK (cm)

LOOP TACK (N/25mm)
SIS/SBS based HMPSA for OPP Packaging Tapes

E-2211 / ECR-373 in V 4511 / DPX 579 50 / 50

SHEAR ON CARDBOARD AT 40°C (Minutes)

BLEND VISCOSITY AT 175°C (CPS)
SIS/SBS based HMPSA for OPP Packaging Tapes

V4511 / DPX 579 in E-2211 / ECR-373 80 / 30

Figure 8
SIS/SBS based HMPSA for OPP Packaging Tapes

V 4511 / DPX 579 in E-2211 / ECR-373 80 / 30

Figure 9

**SHEAR ON CARDBOARD AT 40°C (Minutes)**

**BLEND VISCOSITY AT 175°C (CPS)**
Calculated HMPSA formulation for maximum shear on cardboard at 40°C
SIS/SBS based HMPSA for OPP Packaging Tapes

DMA ANALYSIS OF SELECTED SIS / SBS BASED HMPSA COMPARED TO SIS BASED HMPSA

Formulations:
- Blend 1: SIS / SBS / RESIN / OIL 50 / 50 / 110 / 10
- Blend 2: SIS / SBS / RESIN / OIL 50 / 50 / 100 / 5
- Blend 3: SIS / SBS / RESIN / OIL 50 / 50 / 110 / 5
- Blend 4: SIS / RESIN / OIL 100 / 110 / 10
SIS/SBS based HMPSA for OPP Packaging Tapes

**Figure 12**

**OPP TAPE PERFORMANCE FROM PILOT OPERATIONS**

- V 4111/DPX 579/E-2211/ECR-373/Oil 50/50/80/30/10 (Form. 1)
- V 4111/DPX 579/E-2211/ECR-373/Oil 40/60/70/40/10 (Form. 2)
- V 4111/E-2211/Oil 100/110/10 (Form. 3)
SIS/SBS based HMPSA for OPP Packaging Tapes

COMMERCIAL PLANT COATING TRIAL

Operation
- State of the art HMPSA coating line, > 1.6 meter wide, max. speed > 500 m/min. (1520 ft/min.)
- Integrated Maris twin screw extruder with continuous gravimetric feeding
- Inline release coating

Extruder Mixing
- SIS and SBS feeding in first port
- Temperatures: 30 - 190 °C
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Coating
- Slot die with rotating bar
- Coating Temperature: 175 °C
- Coating onto OPP film, 25 micron
- Coating weight: 18g/sqm
- Coating Speed: 200 m/min (610 ft/min)
SIS/SBS based HMPSA for OPP Packaging Tapes

OPP TAPE PERFORMANCE BASED ON COMMERCIAL PRODUCTION

- 180° Peel Adhesion (N/10mm)
- Loop Tack (N/25mm)
- Ball tack (cm)
- Shear on cardboard @ 40°C (hrs)

SIS/SBS COMMERCIAL TAPE: V 4511/DPX 579/E-2211/ECR-373/OIL 50/50/80/30/10
SIS COMMERCIAL TAPE
Summary & Conclusion

- A high performance SIS/SBS system based HMPSA for OPP packaging tapes has been developed.

- The use of a tailored, pure triblock SBS is a valid option to reduce cost without giving up on performance.

- Experimental statistical formulation design was a very helpful tool to develop best HMPSA composition.

- Extensive mixing tests, both z-blade and twin screw extruder based, have shown that there is no danger of gel development or extruder blocking.

- Tape samples from a commercial plant trial confirm the performance expectations for a high quality packaging tape.

- Our labs work on a development program to reduce the number of formulation ingredients without adversely affecting the tape performance.