ARLANXEO
Performance Elastomers

HALOBUTYL TIRE INNER LINERS

The purpose of this guide is to provide assistance in processing 100 % halobutyl inner liners. It has been developed through various factory evaluations and presents the problems that most frequently arise, probable causes, and suggested remedies. The guidelines are general in nature, and causes and remedies may differ due to individual plant conditions and equipment. In situations where a selected remedy may not work or only be partially successful, being aware of some potential causes should help to determine which causal factors may be contributing to the problem. Designed experiments may also help in this process.

The following formulation is a good starting point for development of a 100 % bromobutyl inner liner; it exhibits a good balance of processing and performance parameters.

Starting Formulation

ARLANXEO X_Butyl® BB 2030	100 (phr)
N660 black	60
Refined Paraffinic Mineral oil	7
Tackifier Resin	4
Stearic Acid	1
MBTS	1.3
Sulfur	0.5

PROBLEM SOLVING GUIDE

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A. Mixing Problems

PROBLEM	POSSIBLE CAUSES	POSSIBLE REMEDIES
1) Undispersed lumps of polymer	1) Incorrect batch size 2) Polymer too cold 3) Oil added too early 4) Internal mixer too hot 5) Pre-mastication 6) Other	1) Ensure internal mixer is full; ram should seat just before dump; check by adding 5 kg pieces of base stock and observe behavior of ram 2) Bring polymer to 60 ºF (15 ºC); store skids at least 2 weeks at required temperature or break down the skid and leave bales on trays for 24 hours 3) Adjust oil addition timing 4) Check temperature control unit and ensure proper cooling 5) Add filler with the polymers 6) Use lower Mooney version of polymer
2) Slow mixing	1) Incorrect batch size 2) Oil added too late 3) Slow black incorporation	1) Ensure internal mixer is full. Ram should seat just before dump. Check by adding 5 kg pieces of base stock and observe behavior of ram 2) Adjust time of oil addition 3) Check calibration of mixer. Add wetting agent (e.g. stearic acid) at start of cycle
3) Scorching (in a two-pass mix)	1) Dump temperature too high 2) Ingredients causing scorch 3) Polymer/black scorch in first-pass mix	1) Check mixer thermocouple - First-pass 275 ºF (135 ºC) max for BIIR - First-pass 295 ºF (145 ºC) max for CIIR - Second-pass 230 ºF (110 ºC) max; increase cooling, reduce rotor speed 2) Check ingredients: - Acidic materials decrease scorch safety of HIIR - Basic materials increase scorch safety of HIIR - Amine antioxidants/antiozonants reduce scorch in HIIR 3) Add MBTS with black in first-pass mix

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B. Processing Problems

PROBLEM	POSSIBLE CAUSES	POSSIBLE REMEDIES
1) Compound scorching (see also A.3)	1) Compound ingredients 2) Mixing and/or processing temperatures too high 3) Adding zinc oxide in first-pass mix	1) Review all compounding ingredients (see A. mixing pProblems); phenolic resins, wood rosins, aromatic oils reduce time to scorch; avoid using amines, quinone type antioxidants/antiozonants in BIIR compounds 2) See A.3 Scorching 3) Move zinc oxide to final mix
2) Insufficient tack	1) Additives migrating to the surface (i.e. blooming) 2) Contamination on the surface of the calendered sheet 3) Excessive tension when rolling up inner liner into the storage interleaving material – can result in an impression on the inner liner 4) Compound Mooney too high 5) Compound partially scorched	1) Reduce or eliminate materials which could be migrating (aromatic oils, fatty acid esters, wax, sulfur); use cooling drums or metal belt to cool inner liner to ambient temperature immediately after calendering or extrusion to retard surface migration; lower compound temperature on the calender rolls 2) Clean or replace the liner roll interleaving or separator material; clean cooling equipment 3) Reduce tension when rolling up the inner liner into the interleaving material; optimize compound Mooney. 4) Add oil if possible or use lower Mooney HIIR 5) See B.1 Compound scorching
3) Sticking to metal	1) Compound Mooney too low 2) Too much tackifier 3) Other	1) If possible increase filler level or reduce oil level; adopt higher Mooney version of HIIR 2) Decrease tackifier level 3) Avoid use of untreated clay; check oil weighing system; check temperature control unit for mixer body, door and rotors

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B. Processing Problems continued

PROBLEM	POSSIBLE CAUSES	POSSIBLE REMEDIES
4) Sticking to mill or calender	1) Mill or calender roll temperatures	1) Adjust temperature: HIIR's tend to follow cooler roll; stickiness usually least when mill/calender roll at 203 ºF (95 ºC); check cooling circuit for fouling
5) Shrinkage of calendered sheet	1) Compound scorchy. 2) Poor cooling. 3) Excessive stretching or pull-down. 4) High compound viscosity.	1) See B.1 Compound scorching 2) Improve cooling prior to windup 3) Reduce tension in windup equipment 4) Adopt lower Mooney version of HIIR; decrease compound Mooney
6) Blisters within plies	1) Air in the mixer is incorporated in the compound and not removed 2) Air trapped in calender feed strip	1) Check to ensure optimum batch size (See A. Mixing Problems) 2) Maintain minimum rolling banks on mill and calender nips: - Reduce feed mill nip gauge - A small mill friction ratio is desirable (1.05:1.0) - Ensure mixed compound is properly dried prior to calender warm up milling
7) Blisters between plies	1) Poor consolidation 2) Poor tack	1) Check alignment of consolidation roll; check hardness of consolidation roll; replace or cover with fabric or sponge rubber; decrease consolidation roll diameter; increase consolidation roll pressure; increase compound viscosity; use high angle (> 145 degree) when plying up laminates 2) Increase tack (See B.2 Insufficient tack)
8) Inner liner splitting (after expansion-radial tires)	1) Carcass splitting	1) Improve the green strength of the carcass compound: - Increase the NR content - Reduce the expansion (or lift) - Eliminate "missing" cord material
9) Inner liner splice opening after shaping	1) Insufficient tack 2) Excessive compound shrinkage 3) Other	1) See B.2 Insufficient tack 2) See B.5 Shrinkage of calendered sheet 3) Use splicing tape

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C. Curing Problems

PROBLEM	POSSIBLE CAUSES	POSSIBLE REMEDIES
Inner liner thinning (excessive compound flow)	1) Excessive stretching during 'green' tire assembly 2) Adding "rework" material at the calender feed mill 3) Excessive sticking to calendered inner liner interleaving material 4) Insufficient rubber in the tire shoulder area 5) Tire construction parameters	1) Reduce stretching of inner liner; check assembly drum speed and let-off braking mechanism 2) Add "rework" material at the internal mixer (second-pass only) 3) See B.2 Insufficient tack 4) Increase rubber in tire shoulder area 5) Decrease carcass tension - Add NR gumstrips to liner in the tire shoulder area - Radiation pre-cure of body plies - Use an unbalanced body ply with the thickest rubber side against the inner liner
Cured tire inner liner blisters	1) Excessive air trapped at tire assembly 2) Poor inner liner to carcass tack 3) Poor hot cured adhesion between liner and carcass	1) Perforate carcass plies; improve stitching procedure during tire building. 2) Improve tack (see B.2 Insufficient tack); check blisters for contamination and eliminate. 3) Use BIIR rather than CIIR

** Due to the number of variables which can influence halobutyl inner liner problems, please use this guide as a starting point only. The customer must fully investigate all problems and use professional judgement when deciding upon a course to remedy any given problem. The information provided herein must be determined by the customer to be suitable for its intended uses and purposes.*

***Product Safety**:*

Relevant safety data and references as well as the possibly necessary warning labels are to be found in the corresponding safety data sheets.

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Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the ARLANXEO products mentioned in this publication. For materials mentioned which are not ARLANXEO products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be followed. Before working with any of these products, you must read and become familiar with the available information on their hazards, proper use and handling. This cannot be overemphasized. Information is available in several forms, e.g., material safety data sheets and product labels. Consult us through your ARLANXEO TSR representative.

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Note: The information contained in this publication is current as of May 2017. Please contact ARLANXEO USA LLC to determine if this publication has been revised.