TUBALL™ MATRIX

PROCESSING GUIDELINES

TUBALL™ MATRIX 610
for anti-static colored EPDM compounds
(peroxide and sulfur curing systems)

Contents

V03_20220808

MIXING EQUIPMENT

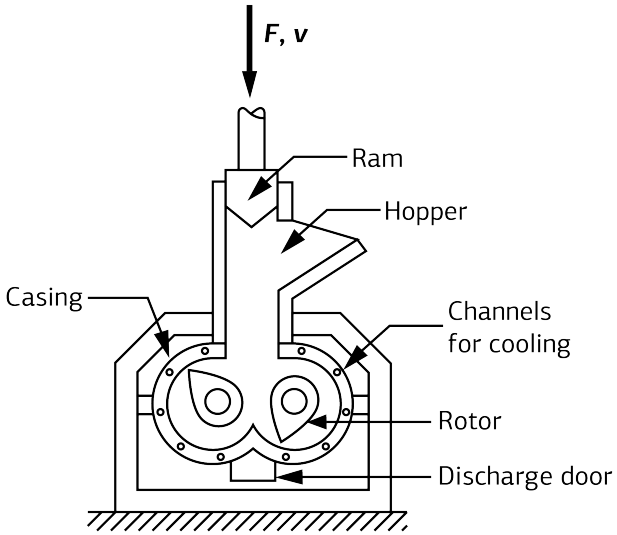


Figure 1. Internal mixer

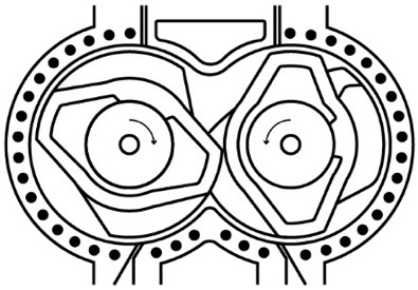


Figure 2. Intermeshing rotors configuration (Intermix)

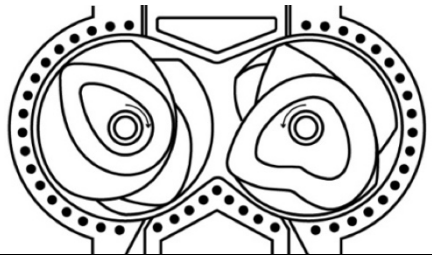


Figure 3. Tangential rotors configuration (Banbury)

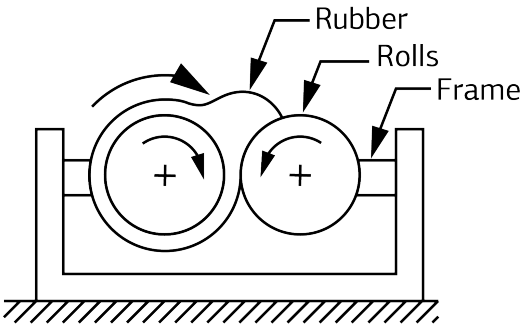


Figure 4. 2-roll mill

DILUTION PRINCIPLES

Recommended dosage

For initial evaluation of **TUBALL™ MATRIX 610** it is recommended to test several dosages such as 3, 4 and 6 wt.% to determine the optimum dosage in order to optimize the formulation.

The most efficient working concentration of **TUBALL™ MATRIX** must be determined experimentally at the production facility, as it depends on the intended use of the prepared rubber mixture and on the process.

COMPOUNDING

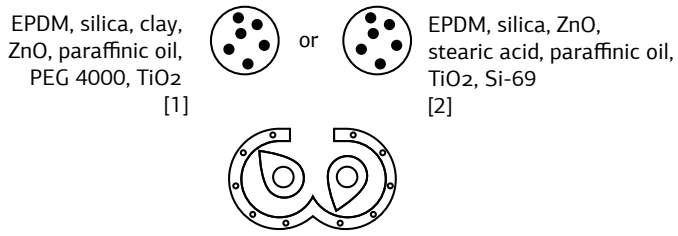
Examples of two basic formulation types (peroxide & sulfur curing) with calculation of the concentration of **TUBALL™ MATRIX** in a rubber compound are shown below.

Compound	**Peroxide curing system**			**Sulfur curing system**		
	Reference, phr	**With TUBALL™, phr**		**Reference, phr**	**With TUBALL™, phr**	
TUBALL™ MATRIX contents, wt.%	**-**	**3**	**6**	**-**	**3**	**6**
EPDM	100	100	100	100	100	100
TUBALL™ MATRIX 610	–	5.9	12	–	5.4	11.1
Plasticizer (Paraffinic oil)	5	5	5	5	5	5
PEG 4000	2	2	2	–	–	–
CaCO3	10	10	10	–	–	–
Silica	43	43	43	50	50	50
Clay	10	10	10	–	–	–
TiO_2	5	5	5	5	5	5
ZnO	8	8	8	5	5	5
TAIC	3	3	3	–	–	–
Peroxide (BIPB-40-GR)	3	3	3	–	–	–
Stearic acid	–	–	–	1	1	1
Si 69	–	–	–	5	5	5
Sulfur	–	–	–	1.5	1.5	1.5
MBT	–	–	–	0.5	0.5	0.5
TMTD	–	–	–	1	1	1
Total	**189**	**194.9**	**201**	**174**	**179.4**	**185.1**

TUBALL™ MATRIX 610 addition in EPDM-based compound using internal mixer – Intermix type

Two-stage mixing process for rubber preparation by internal mixer Intermix type (SKI-3L, intermeshing rotors configuration (Figure 2), rotors speed 50 rpm) and 2-roll rubber mill (roll diameter 200 mm, length 400 mm, friction 1:1.2) are used.

Add **TUBALL™ MATRIX 610** at the second mixing stage at the same time as other ingredients. The compounding process for two curing systems is shown below.



STAGE 1
COMPOUND PREBLENDING
Internal mixer

Put ingredients into mixing chamber: Peroxide curing system [1], Sulfur curing system [2] (0.5 min)

Mixing – 3 min

Sweep ram – 3.5 min

Allow the batch to mix until a temperature of 150°C or a total mixing time of 5 min is reached, whichever occurs first. Discharge the batch

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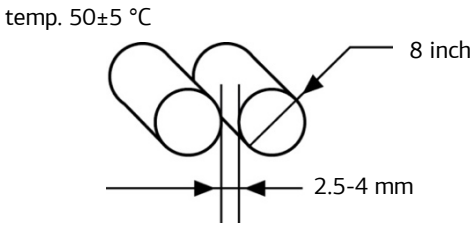

example of a roll gap with a roll diameter of 8 inches

Band and cross-blend (2-roll mill)

Pass compound through 2-roll mill

After first stage, compound should be stored from 1 to 24 hours under normal conditions.

After thermostating process, second mixing stage is performed

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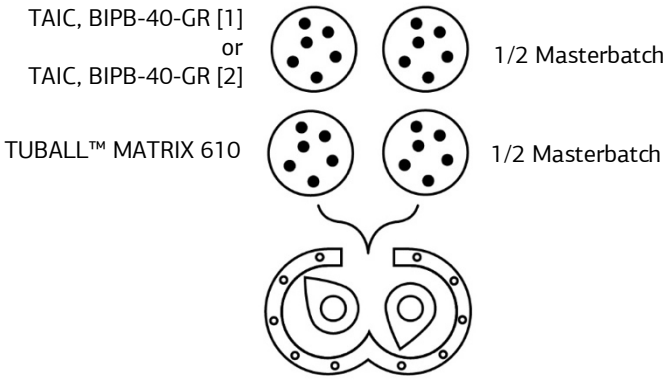

STAGE 2: TUBALL™ MATRIX introduction stage (Internal mixer)

- 1/2 Masterbatch from stage 1
- Add ingredients (Peroxide curing system [1], Sulfur curing system [2])
- Add TUBALL™ MATRIX 610
- 1/2 Masterbatch from stage 1

Total time 0,5 minutes

Allow the batch to mix until a temperature of 100°C for peroxide curing system or 80°C for sulfur curing system or a total mixing time of 2 min is reached, whichever occurs first. Discharge the batch

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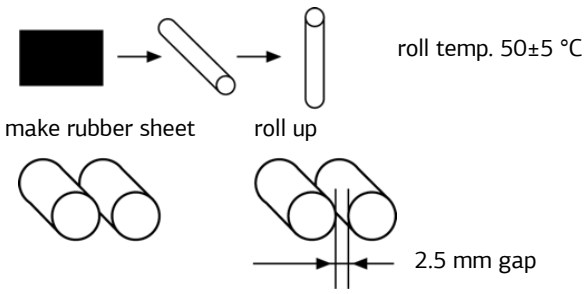


example of a roll gap with a roll diameter of 8 inches

Band and cross-blend (2-roll mill)

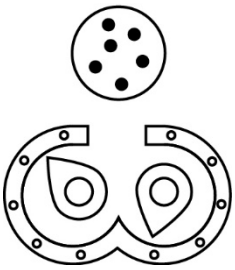
Pass the rolled batch endwise through the mill six times After mixing, compound should be stored from 1 to 24 hours under normal conditions.

TUBALL™ MATRIX 610 addition in EPDM-based compound using internal mixer – Banbury type

Two-stage mixing process for rubber preparation by internal mixer Banbury type (Brabender 350 S, tangential rotors configuration (Figure 3), rotors friction coefficient 1:1.1, mixing chamber temperature – 60°C, ram pressure – 4 bar, aill factor – 0.7) and 2-roll rubber mill (roll diameter 200 mm, length 400 mm, friction 1:1.2) are used.

There are two options to add **TUBALL™ MATRIX 610** into rubber compound: **at the end of the first stage, or at the second stage.**

Required amount of EPDM



STAGE 1: COMPOUND PREBLENDING (internal mixer)

Step 1

Set rotors speed at 10 rpm

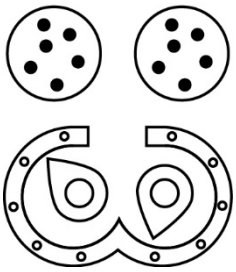
Add EPDM into mixing chamber

Lower the ram

Rubber mixing at 50 rpm rotors speed (1 min)

1/3 of previously mixed PEG 4000, CaCO3, Silica, Clay, TiO2, ZnO

1/3 of total amount of plasticizer



Step 2

Decrease rotors speed to 10 rpm

Open ram

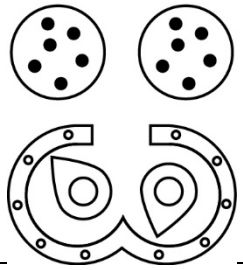
Add 1/3 of total amount of previously mixed PEG 4000, CaCO3, Silica, Clay, TiO2, ZnO and 1/3 of total amount of plasticizer (0.4 min)

Lower the ram

Rubber mixing at 50 rpm rotors speed (1 min)

1/3 of previously mixed PEG 4000, CaCO3, Silica, Clay, TiO2, ZnO

1/3 of total amount of plasticizer

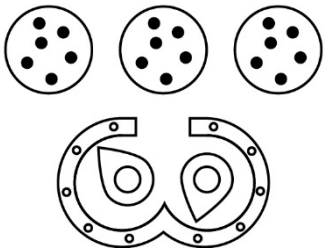


Step 3

Repeat the procedure from Step 2

1/3 of total amount of plasticizer

1/3 of previously mixed PEG 4000, $CaCO_3$, Silica, Clay, TiO_2, ZnO



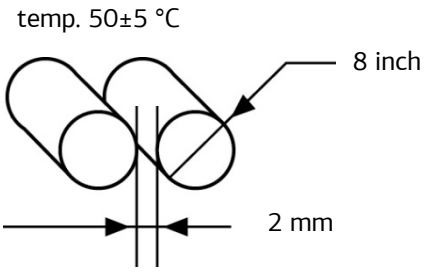
TUBALL™ MATRIX 610 (optional)

Step 4

Repeat the procedure from Step 2

OPTION 1 FOR TUBALL™ MATRIX INTRODUCTION: you can add TUBALL™ MATRIX at this step with other ingredients

Rubber mixing at 50 rpm rotors speed (2 min)



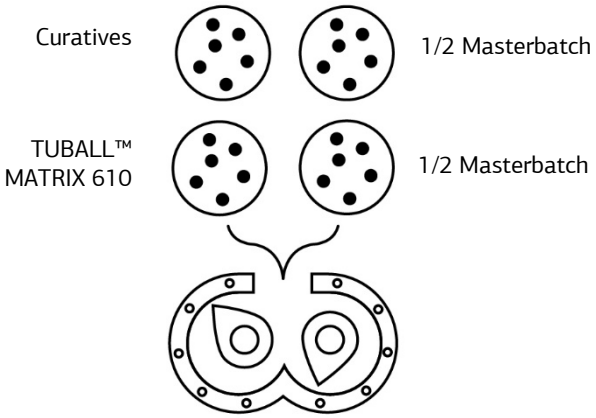
example of a roll gap with a roll diameter of 8 inches

Band and cross-blend (2-roll mill)

Pass compound through 2-roll mill 4 times

After first stage, compound should be stored from 1 to 24 hours under normal conditions.

After thermostating process, second mixing stage is performed



STAGE 2: OPTION 2 FOR TUBALL™ MATRIX INTRODUCTION (internal mixer)

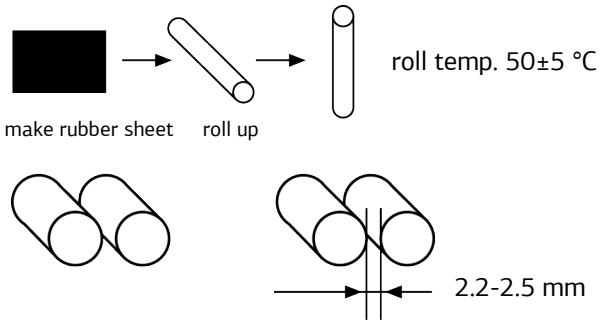
Set rotors speed at 25 rpm

- ½ Masterbatch from stage 1
- Add curatives and TUBALL™ MATRIX
- ½ Masterbatch from stage 1

Lower the ram

Mixing speed is indicated separately for each series of experiments

Dump batch reaching a temperature of 90±5ºC



example of a roll gap with a roll diameter of 8 inches

Band and cross-blend (2-roll mill)

Pass the rolled batch endwise through the mill:

- 6 times at 2.5 mm gap size
- 2 times at 2.2 mm gap

After mixing, compound should be stored from 1 to 24 hours under normal conditions

TUBALL™ MATRIX

TUBALL™ MATRIX 610 addition in EPDM-based compound using 2-roll rubber mill

1st Stage. Initial compound prepared through internal mixer (e.g., Intermix type, rotors speed 50 rpm).

2nd Stage. TUBALL™ MATRIX 610 and curing agents were added at the second mixing stage using 2-roll rubber mill.

Batch weight: 1,000 g.

NOTE: batch weight can be adjusted according to 2-roll mill used.

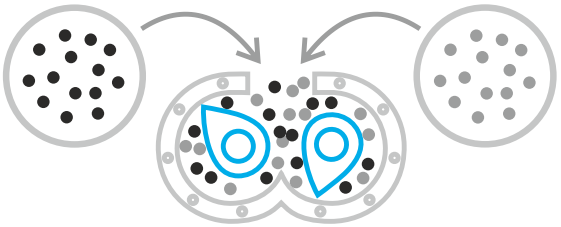
MIXING PROCEDURE

Equipment	Internal mixer	2-roll mill (Roll diameter – 200 mm, friction – 1:1.1, rolls speed – 22.7:25, roll temperature: 50+5 °C)

Stage 1

COMPOUND PREPARATION
Internal mixer

Required amount of EPDM

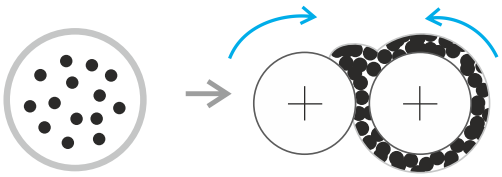


Chemicals except curing agent and TUBALL™ MATRIX

Stage 2

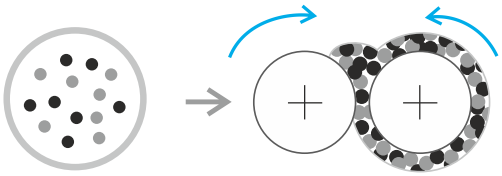
COMPOUNDING WITH TUBALL™ MATRIX
2-roll mill

2.1. EPDM from stage 1



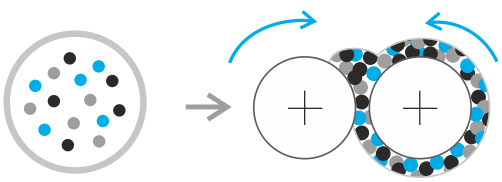
Gap size — 0.5 mm
Mixing time — 2 min

2.2. Add curing agent



Mix until homogeneous
Mixing time — 3 min

2.3. Add TUBALL™ MATRIX 610

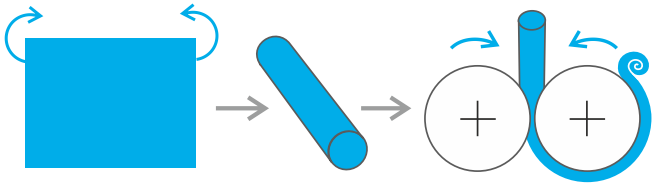


Mix until homogeneous
Mixing time — 5 min
Increase gap to 2 mm

Decrease rolls speed to take off the mixture

Stage 3

"ROLL AND UPEND" MIXING
2-roll mill



Gap size — 0.5 mm
10 cycles
Increase gap to 2—2.5 mm

Continue rolling the compound to reach ~2 mm thickness
Make sheet and conditioning before curing for 1 to 24 hours under normal conditions

CURING CONDITIONS

The following curing parameters were used (**may vary based on your MDR results)**:

Curing system	Curing sample dimensions, mm	Pressure, kgf/cm^2	Temperature, ºC	Time, min
Peroxide	145×145×2	200	180	20
Sulfur			160	40

DETERMINATION OF PERFORMANCE FROM TUBALL™ MATRIX

The complex of rubber properties may be determined according to the following international standards:
ASTM D 412 – Tension characteristics;
ASTM D 2240 – Shore A Hardness;
ASTM D 395 – Compression set;
ASTM D 257, D 991 – Electrical resistance;
ASTM D 5289 – Vulcanization characteristics;
ASTM D 5963 – Abrasion resistance;
ASTM D 624 – Tear Strength, etc.

If there are special requirements for the rubber, or other operational needs, other tests as defined by the user may need to be conducted.

ADJUSTMENT OF OIL/PLASTISIZER CONTENT IN FORMULATION

The total plasticizer content will be increased with **TUBALL™ MATRIX** addition compared to the reference compound. Depending on the dosage of **TUBALL™ MATRIX,** plasticizer content may be adjusted in order to avoid a significant impact on viscosity and stiffness and to optimize the final properties.

ELECTRICAL RESISTIVITY MEASUREMENTS

It is recommended to follow international standards for measurement of electrical properties in the laboratory and for molded parts. Non-standard methods and the accuracy of the handheld devices and surface quality of samples can affect the data.

OCSiAl supports customers to obtain qualified electrical resistivity measurements. To perform the correct measurements, please refer to the Electrical resistivity guidelines on our YouTube channel.

Alternatively, contact our regional offices and technical support centers to receive a copy of the guidelines or request measurements of your samples.

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