TUBALL™ MATRIX

PROCESSING GUIDELINES

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

RECOMMENDATIONS ON USE OF TUBALL™ MATRIX 610 beta

MIXING EQUIPMENT

Optimal mixing is achieved with a combination of an internal mixer and several passes in a 2-roll mill. The 2-roll mill is useful for creating the high shear strain that is needed for dispersion of small particles such as nanotubes.

Figure 1. Internal mixer

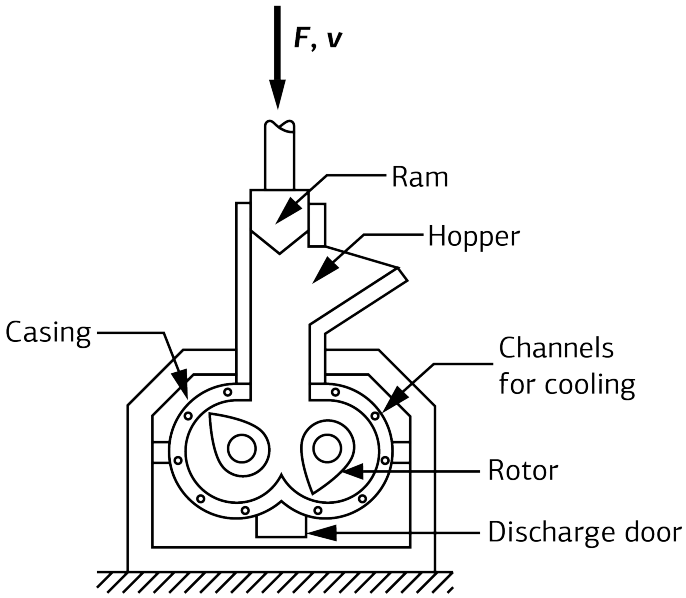
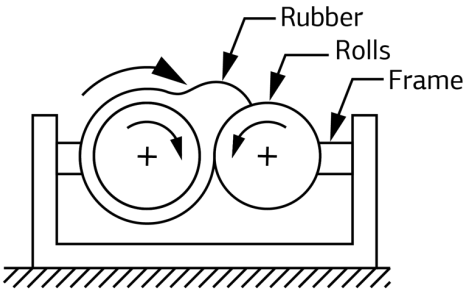


Figure 2. 2-roll mill



DILUTION PRINCIPLES

Recommended dosage

For initial evaluation of **TUBALL™ MATRIX 610 beta** it is recommended to test several dosages as 3, 4 and 6 wt.% to define an optimum.

Examples of two basic formulation types (peroxide & Sulphur curing) with calculating 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 beta	–	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	–	–	–

TiO2	5	5	5	5	5	5
ZnO	3	3	3	5	5	5
TAIC	8	8	8	–	–	–
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**

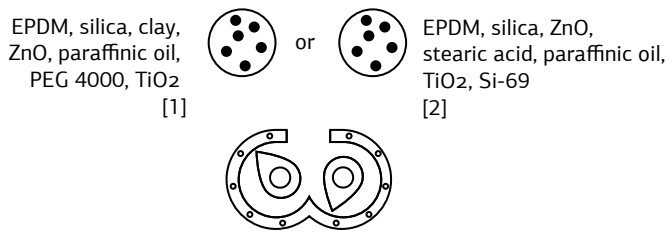
It is recommended that laboratory tests be carried out to study the effect of **TUBALL™ MATRIX** concentration on the properties of samples in order to optimize the formula used. The most efficient working concentration of **TUBALL™ MATRIX** needs to be determined directly at the production facility, as it depends on the purpose of the prepared rubber mixture and on the process.

COMPOUNDING

OPTION 1 (TUBALL™ MATRIX 610 addition in EPDM based compound with using Internal mixer)

Two-stage mixing process for rubber preparation by internal mixer rotor type – Intermix (SKI-3L rotors speed of 50 rpm) and 2-roll rubber mill, roll diameter – 200 mm, length – 400 mm, friction 1:1.2 are used.
Add **TUBALL™ MATRIX 610 beta** on second mixing stage at the same time with other ingredients.
The compounding process for two curing systems is shown below.

Introduction of TUBALL™ MATRIX



STAGE 1: COMPOUND PREBLENDING (Internal mixer)

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

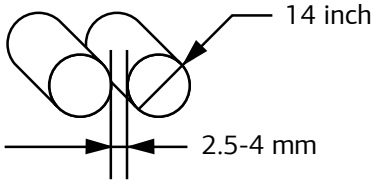
Mixing (3 min)

Sweep ram (3.5 min)

Dump butch, after 5 minutes of mixing or after reaching a temperature of 150 ℃ (5 min)

Total time 12 minutes

temp. 50±5 ℃

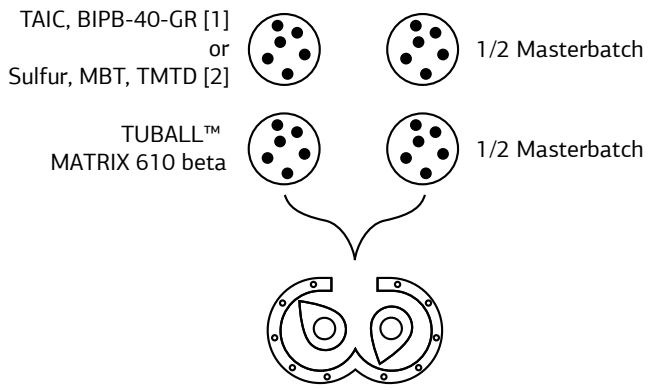


Band and cross-blend (2-roll mill)

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

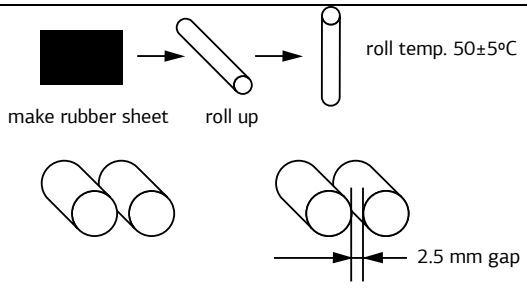


STAGE 2: MATRIX introduction stage (Internal mixer)

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

Total time 0,5 minutes

Dump butch after 2 minutes of mixing time or after reaching a temperature of 100 °C for peroxide curing system or 80 °C for sulfur curing system (2 min)



Band and cross-blend (2-roll mill)

Pass compound through 2-roll mill, form it into a tube

Turn on 90 ºC and repeat 6 times

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

OPTION 2 (TUBALL™ MATRIX 610 addition in EPDM based compound with using 2-roll rubber mill)

Compounding process

1st Stage. Initial compound prepared through internal mixer rotor type – Intermix (SKI-3L rotors speed of 50 rpm). Refer to Option 1 Stages 1-2.

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

Batch weight - 1000 g.

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

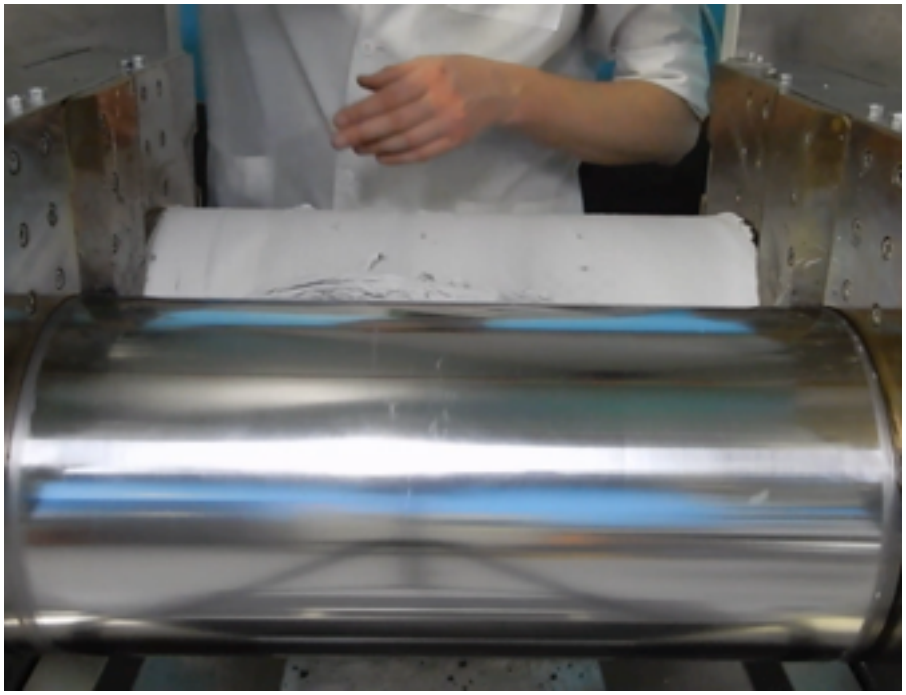
Conditions for two-roll mill:

- speed ratio 1:1.1

- rolls surface temperature 50±5 º C.

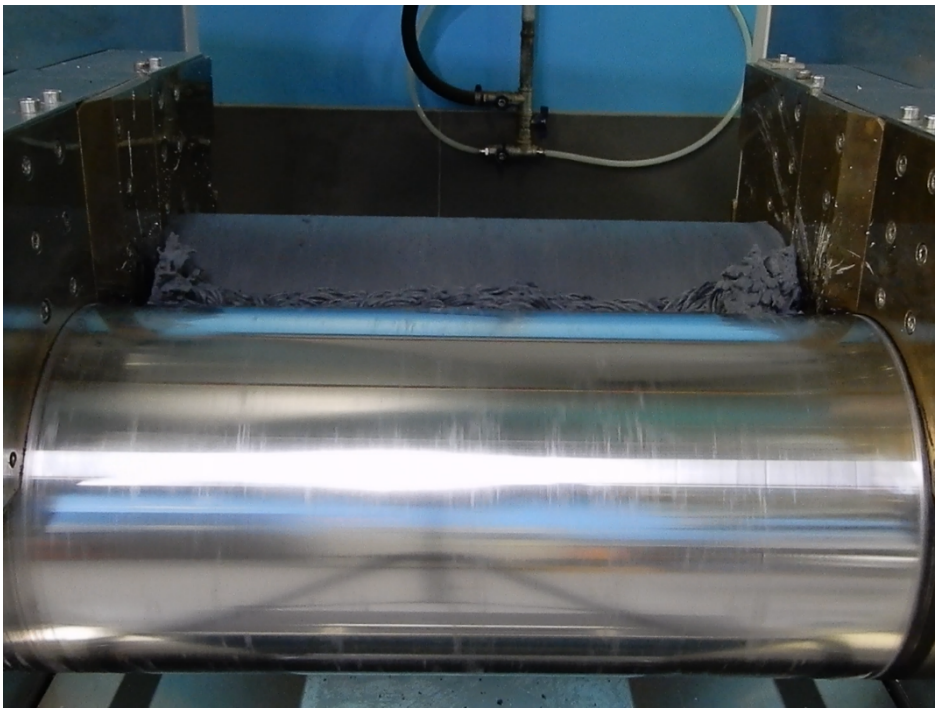
MIXING PROCEDURE

1. Set gap size 0.5mm, turn on the machine. Add compound from the 1st stage, plastication (approximately 2 minutes).



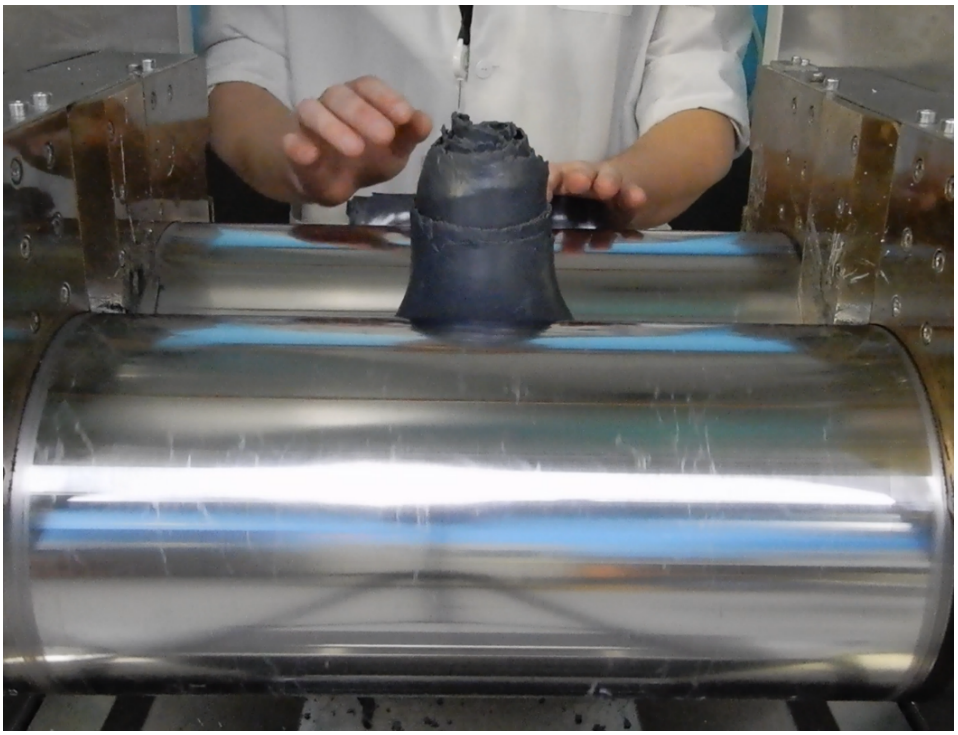
2. Add curing agent, mix until homogeneous.

3. Add **TUBALL™ MATRIX 610 beta**, mix until homogeneous.



4. Decrease roll speed to take off the mixture.

5. “Doll” mixing 10 times.



6. Rolling the compound till ~2mm thickness.

Pass compound throw two-roll mill at the gap size 2.5 mm to form the rubber sheet, rolls temperature 50±5ºC. After mixing compound stored from 1 to 24 hours under normal conditions before curing.

Curing conditions

The following curing parameters was used (may vary basing on your MDR results):

	Peroxide curing system	Sulfur curing system
Pressure, kgf/cm^2	200	200
Temperature, °C	180	160
Time, min	20	40
Curing sample dimensions, mm	145x145x2	145x145x2

Determination of performance from TUBALL™ MATRIX

Complex of rubber properties could be determined according to the following international standards:
ASTM D 412 – Strength indices;
ASTM D 2240 – Shore A Hardness;
ASTM D 395 – Compression set;
ASTM D 257, D 991 – Electrical resistance;
ASTM D 5289 – Rheometric data;
ASTM D 5963 – Abrasion indices;
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 might need to be conducted.

NOTE.

Tuning of oil/plastisizer content in formulation

The total plasticizer content will be increased with **TUBALL™ MATRIX** addition compared with the reference compound. Depending on the dosage of **TUBALL™ MATRIX** plasticizer content may be tuned 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 the international standards for measurement of electrical properties in the laboratory and for molded parts. Non-standard methods and accuracy of the handheld devices and surface quality of samples can affect the data.

OCSiAl supports customers for qualified electrical resistivity measurements. To perform the correct measurements please refer to the Electrical resistivity guidelines at YouTube channel https://www.youtube.com/watch?v=4cgU9mkHiKo

Or contact our regional offices and technical support centers to have a hard copy of the guidelines or request for measurements of your samples.