TUBALL™ LATEX H_2O

USAGE GUIDELINE

FOR PRODUCTION OF ANTISTATIC NATURAL/SYNTHETIC LATEX COMPOUNDS

CONTENTS

1. Equipment

- Overhead stirrer

2. Ingredients

- NR or NBR Latex
- Chemical dispersions as required in latex compound
- Stabilizer such as Tamol NN9104 and SDBS
- **TUBALL™ LATEX H_2O** suspension in H_2O (0.2% TUBALL™ content);
- pH adjuster

3. Mixing procedure

Determine the required amount of **TUBALL™ LATEX H_2O.** The table below shows the amount of **TUBALL™ LATEX H_2O** 0.2% suspension to be added to 1 litre of latex to prepare dipping solutions with loading levels of TUBALL™ carbon nanotubes (CNT) from 0.03 wt.% to 0.1 wt.% (based on the solid rubber content).

Solid content of raw latex	Amount of TUBALL™ LATEX H_2O 0.2% suspension to add (g per 1kg raw latex) to obtain the indicated loading level of TUBALL™ carbon nanotubes							
	0.03 PHR CNT	0.04 PHR CNT	0.05 PHR CNT	0.06 PHR CNT	0.07 PHR CNT	0.08 PHR CNT	0.09 PHR CNT	0.1 PHR CNT
45%	67.5	90	112.5	135	157.5	180	202.5	225
50%	75	100	125	150	175	200	225	250
60%	90	120	150	180	210	240	270	300

Example A:

Preparing latex compound with **0.05 PHR** TUBALL™:

- When using latex with **45%** solid content and **TUBALL™ LATEX H_2O 0.2%** suspension, add 112.5 g of the suspension (**0.225 g** TUBALL™ content) to 1 kg of raw latex (**450 g** solid rubber content).

Example B:

Preparing latex compound with **0.05 PHR** TUBALL™:

- When using latex with **60%** solid content and **TUBALL™ LATEX H_2O 0.2%** suspension, add 150 g of the suspension (**0.3 g** TUBALL™ content) to 1 kg of raw latex (**600 g** solid rubber content).

Example of formulation with 0.045 PHR TUBALL™:

Component	Function	PHR
NBR Latex	Polymer	100
Sulfur	Vulcanizing Agent	0.8
ZnO	Activator	1.2
ZDEC	Accelerator	0.75
TiO_2	Pigment	2
Tamol NN9104	Stabilizer	0.3
SDBS	Stabilizer	0.3
TUBALL™ carbon nanotubes	Performance Additive	0.045
KOH (5% solution)	pH adjuster	Adjust dosage to achieve pH 9.8 to 10.2

Note: All the components should be added in chronological order.

Step 1

Components: NBR Latex

Stir the latex using an overhead stirrer such as the Heidolph RZR 2041 for 10 minutes at 60 rpm (Figure 1). **Maintain the same rotational speed throughout the whole compounding process.**

The optimal geometry of the mixing unit is shown in Figure 2.

Figure 1.

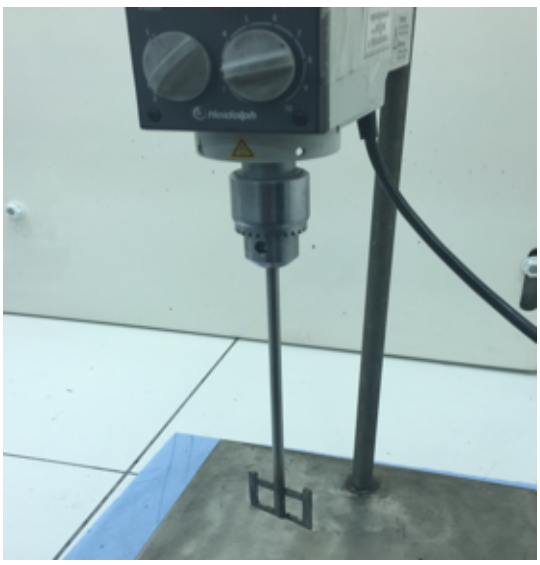


Figure 2

Step 2

Prepare chemical dispersions with stabilizers as required (vulcanising agent, activator, etc.) Add DI water if necessary for easy handling and stir the chemical dispersions until homogenous.

Components: Sulfur, ZnO, ZDEC, TiO2, Tamol NN9104, and SDBS.

Add the chemical dispersions into NBR latex gradually. Stir until homogeneous with the speed 60 rpm (Figure 3).

Figure 3

Step 3

Dilute **TUBALL™ LATEX H_2O 0.2%** with DI water, in the ratio depending on the desired TSC of latex compound. (1:2, 1:1, or less).
To ensure stability, add necessary amount of Tamol NN9104 to keep 1% loading level of Tamol in the diluted **TUBALL™ LATEX H_2O 0.2%**.

To prevent agglomeration, diluted **TUBALL™ LATEX H_2O 0.2%** should be stored at temperature below 35ºC. It is recommended to use diluted **TUBALL™ LATEX H_2O 0.2%** within 3 hours after dilution.

Step 4

Gradually introduce diluted **TUBALL™ LATEX H_2O 0.2%** from Step 3 into the NBR latex compound. Mix the compound until a homogeneous colour is achieved (Figure 4).

Step 5

Gradually add 5% solution of KOH until pH 9.8 to 10.2 is achieved.

Figure 4

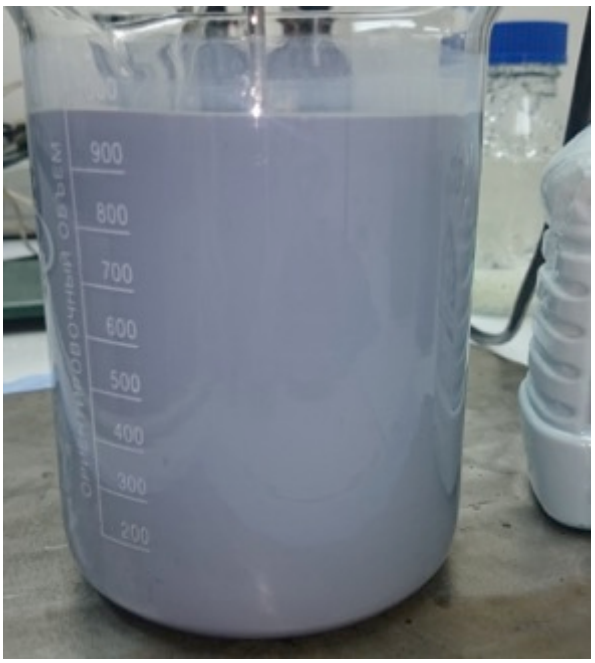


Figure 5

Step 6

Continue stirring compounded NBR latex for 18-24 hours. (Figure 5)

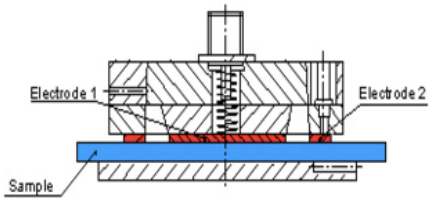
Step 7

Proceed with standard dipping process.

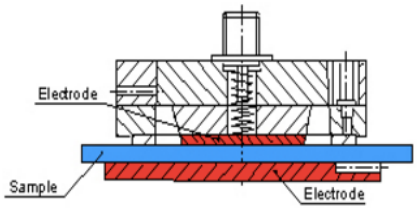
Step 8

Quality control. Check TUBALL™ dispersion quality in the rubber. OCSiAl recommends the following method:

- Dielectric measurements (EN 16350 or EN 1149).



EN 1149-1 Electrostatic properties. Surface resistivity (test methods and requirements)



EN 1149-2 Electrostatic properties. Test methods for measurement of the electrical resistance through a material (vertical resistance)

4. Problems and Solutions

Problem	Possible solution
Electrical resistivity too high	Increase rotational speed to 80-100 rpm
	Add more **TUBALL™ LATEX H_2O 0.2%**
	Perform washing process to remove substances blocking on the surface
Visible TUBALL™ agglomerates in latex compound	Make sure ≤5% KOH solution is added at the last stage of compounding process
	Add more stabilizers (Tamol NN9104 and SDBS) into latex compound (before addition of **TUBALL™ LATEX H_2O 0.2%**)
	Diluted **TUBALL™ LATEX H_2O 0.2%** should be consumed as soon as it is prepared
	Increase rotational speed to 80-100 rpm
Viscosity increase of latex compound	Remove/Reduce thixotropic agent
	Do not mix latex compound with different PHR of TUBALL™
	Consume matured latex compound as soon as it is prepared