TUBALL™ LATEX

PROCESSING GUIDELINES

TUBALL™ LATEX H_2O
for anti-static natural/synthetic latex compounds

V05_20221024

TUBALL™ LATEX

EQUIPMENT

- Overhead stirrer.

INGREDIENTS

- NBR or NR Latex;
- Chemical dispersions as required in latex compound;
- Stabilizer, such as Tamol NN9104 or NN9401 and SDBS;
- DI water (deionized);
- **TUBALL™ LATEX H_2O** suspension (0.2% or 0.5% **TUBALL™** active content);
- pH adjuster.

MIXING PROCEDURE

Determine the target dosage of **TUBALL™ LATEX H_2O** for formulation according to the required dosage of **TUBALL™** in dry rubber content in latex.

$$\textit{target TUBALL™ LATEX } H_2O \textit{ dosage (\%)} = \frac{\textit{target TUBALL™ concentration (\% in dry rubber content)}}{\textit{concentration of TUBALL™ in suspension (\%)}} \textit{ *solid content of latex (\%)}$$

The table below shows the amount in wt.% of **TUBALL™ LATEX H_2O 0.5%** suspension to be added to prepare dipping solutions with loading levels of **TUBALL™** graphene nanotubes (GNT) from 0.03 wt.% to 0.1 wt.% (based on the dry rubber content).

Solid content of raw latex	Amount of TUBALL™ LATEX H_2O 0.5%* suspension to add (wt.% based on the dry rubber content) to obtain the indicated loading level of TUBALL™ GNT							
	0.03 wt.% GNT	0.04 wt.% GNT	0.05 wt.% GNT	0.06 wt.% GNT	0.07 wt.% GNT	0.08 wt.% GNT	0.09 wt.% GNT	0.1 wt.% GNT
45%	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9
50%	3	4	5	6	7	8	9	10
60%	3.6	4.8	6	7.2	8.4	9.6	10.8	12

*If **TUBALL™ LATEX H_20** 0.2% suspension is used, multiply the dosage of suspension by 2.5.

The table below shows the amount of **TUBALL™ LATEX H_2O 0.5%** suspension to be added to 1 kg of latex to prepare dipping solutions with loading levels of **TUBALL™** graphene nanotubes (GNT) from 0.03 wt.% to 0.1 wt.% (based on the dry rubber content, e.g. PHR).

Solid content of raw latex	Amount of TUBALL™ LATEX H_2O 0.5%* suspension to add (g per 1 kg raw latex) to obtain the indicated loading level of TUBALL™ GNT							
	0.03 PHR GNT	0.04 PHR GNT	0.05 PHR GNT	0.06 PHR GNT	0.07 PHR GNT	0.08 PHR GNT	0.09 PHR GNT	0.1 PHR GNT
45%	27	36	45	54	63	72	81	90
50%	30	40	50	60	70	80	90	100
60%	36	48	60	72	84	96	108	120

*If **TUBALL™ LATEX H_20** 0.2% suspension is used, multiply the dosage of suspension by 2.5.

Example A (latex solid content 45%):

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

- When using latex with **45%** solid content and **TUBALL™ LATEX H_2O 0.5%** suspension, add 45 g of the suspension (**0.225 g TUBALL™** content) to 1 kg of raw latex (**450 g** solid rubber content).

Example B (latex solid content 60%):

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 0.045phr (0.06wt.%) 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 (or NN9401)	Stabilizer	0.3
SDBS	Stabilizer	0.3
TUBALL™ graphene 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 the given order.

INTRODUCTION METHOD – OPTION 1

Step 1

Components: NBR Latex.

Stir the latex using an overhead stirrer (for example, Heidolph RZR 2041) for 10 minutes at 60–100 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. Other blade shapes could be used in order to provide the homogeneous dispersion of all the ingredients.

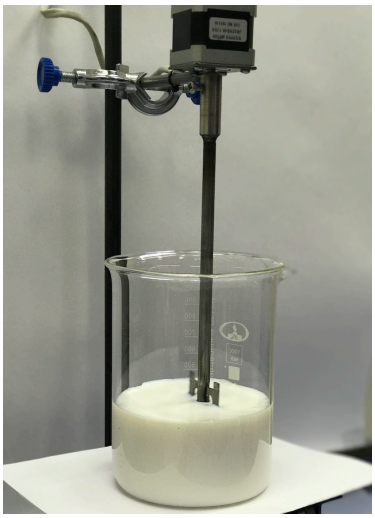


Figure 1

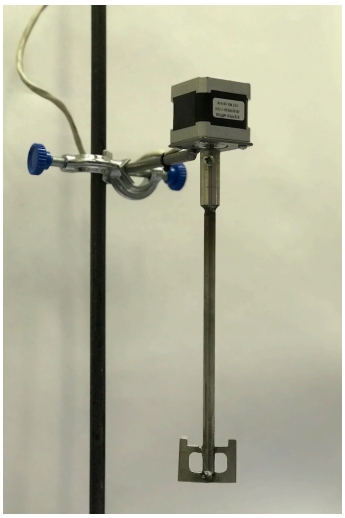


Figure 2

Figure 3

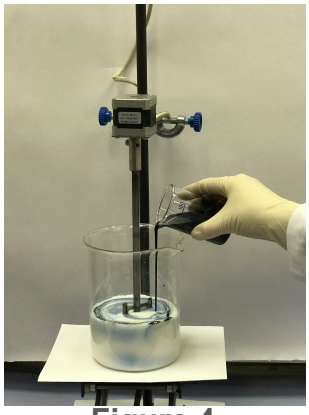


Figure 4

Step 2

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

Components: Sulfur, ZnO, ZDEC, TiO_2, Tamol NN9104, and SDBS.

Add the chemical dispersions into NBR latex gradually one by one in the order given above. Stir until homogeneous at a speed of 60 rpm (Figure 3).

Step 3 (optional)

If necessary, for easier processing (to decrease viscosity) it is possible to dilute **TUBALL™ LATEX H_2O 0.5%** with DI water in a ratio depending on the desired total solid content of latex compound (the ratio may be 1:2.5, 1:1, or less).

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

Step 4

Gradually introduce **TUBALL™ LATEX H_2O** into the NBR latex compound. Mix the compound until a homogeneous color is achieved (Figure 4).

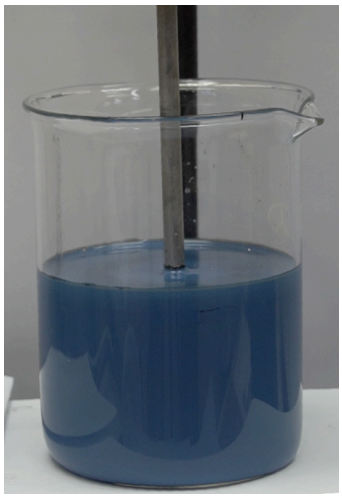


Figure 5

Step 5

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

Step 6

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

Step 7

Proceed with a standard dipping process or preparation of the films/gloves.

NOTE! Compatibility of dispersion with particular compound and/or process may vary depending on several factors.

In case of Introduction method 1 does not fit your compound and/or process, its recommended to test Option 2.

INTRODUCTION METHOD – OPTION 2

Step 1

Components: NBR Latex.

Stir the latex using an overhead stirrer (for example, Heidolph RZR 2041) for 10 minutes at 60–60 rpm (Figure 6). **Maintain the same rotational speed throughout the whole compounding process.**

The optimal geometry of the mixing unit is shown in Figure 7.

Figure 6

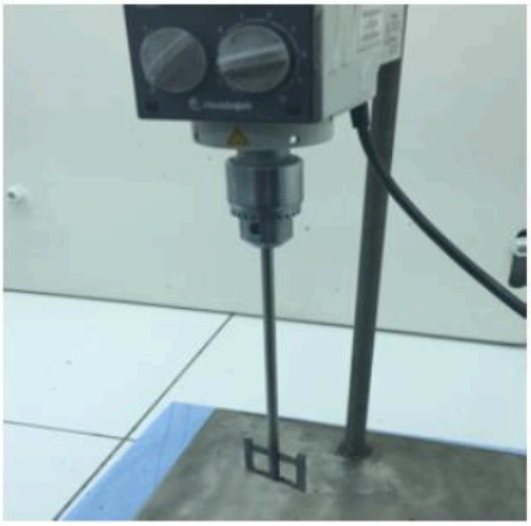


Figure 7

Step 2

Add the pH adjuster (for example, KOH or NH_3) according to formulation.

Add DI water, if necessary to optimize the compounding (optional).

Step 3 (“Masterbatch” Preparation)

Dilute **TUBALL™ LATEX H_2O 0.5%** with DI water in the ratio 1:1, or 1:2. Stir continuously until homogeneous.

In order to keep stability of diluted TUBALL™ LATEX 0.5% dispersion, add 2–3 wt.% of Tamol NN9104 (dry weight calculation is based on the active TUBALL™ LATEX 0.5%).

Then, add the chemicals dispersions according to standard formulation (Sulfur, ZnO, ZDEC, ZDBC, TiO_2).

Stir the obtained dispersion until a homogeneous color is achieved. (Figure 8)

Figure 8

Step 4

Gradually introduce the “Masterbatch” prepared in Step 3 into the NBR latex by sieving using 150-200 mech size filter (to ensure that there is no residue pass over into final compound).

Add DI water, if necessary to optimize the compounding (optional).

Continue stirring (maturation) of compounded NBR latex for 18–24 hours.

Step 5

Proceed with standard dipping process.

QUALITY CONTROL & COLORATION

1. Visual: good film (Figure 9) / poor film (Figure 10).

Microscopy (optional): good film (Figure 11) / poor film (Figure 12).

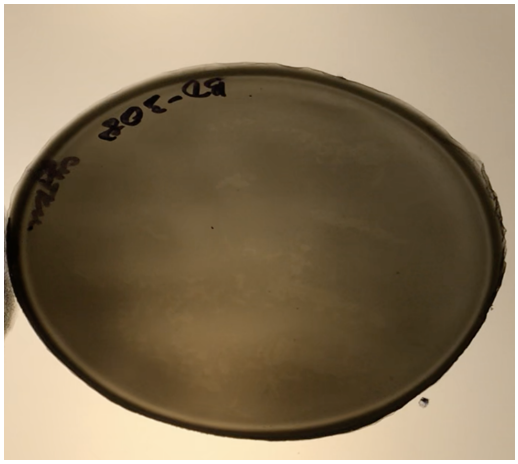


Figure 9

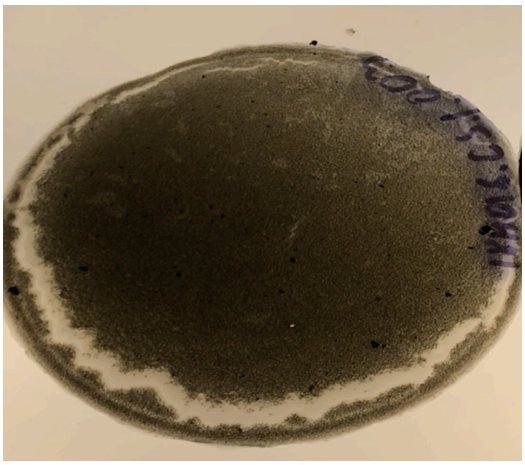


Figure 10

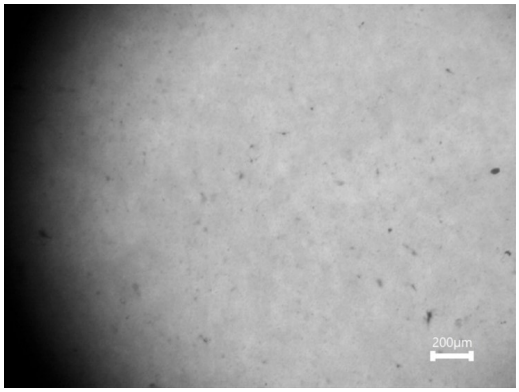


Figure 11

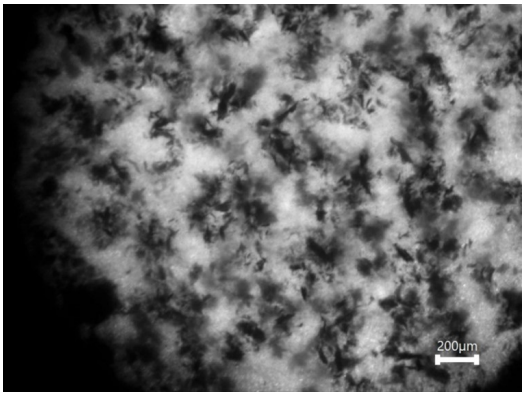
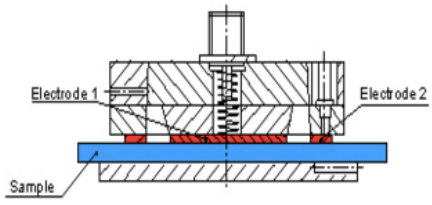


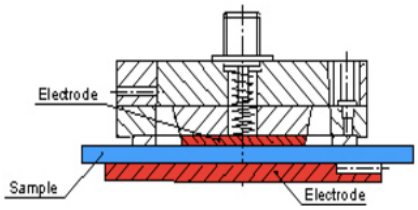
Figure 12

2. **Electrical resistivity:** OCSiAl recommends the following measurement methods:

Dielectric measurements (EN 16350 or EN 1149)*.



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

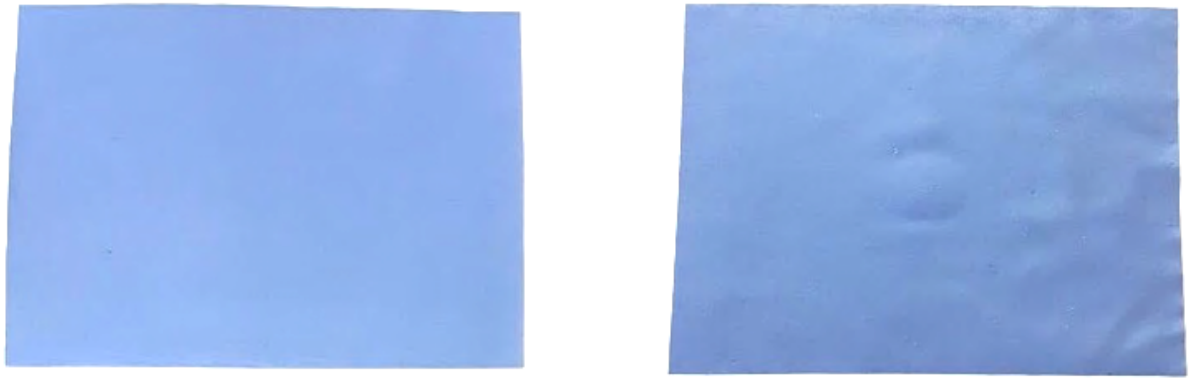


EN 1149-2 Electrostatic properties. Test methods for measurement of the electrical resistance through a material (vertical resistance)

* For more info please refer to the OCSiAl electrical resistivity measurements guide available in pdf or video format https://youtu.be/4cgU9mkHiKo

Note. Colored options are possible with using color pigments. Combination with TiO_2 is required to obtain bright color (Figure 13).

Example of colored films with using 1phr TiO_2 and 1–2 phr of violet pigment.



Inner side Outer side

Figure 13. Anti-static nitrile film with 0.06 wt.% TUBALL™. Surface resistivity of 10^7 Ω/sq.

TROUBLESHOOTING

Problem	Possible solution
Electrical resistivity too high	Increase the dosage of **TUBALL™ LATEX H_2O.**
	Make sure that the film surface is clear from any contamination and that good contact is made between the electrode and the sample.
Visible **TUBALL™** agglomerates in latex compound	Make sure that pH of suspension is not dramatically differ to latex, to avoid the pH shock (add≤5% KOH solution at the final stage of the compounding process, etc.).
	Increase slightly the dosage of stabilizers (Tamol NN9104 and/or SDBS) added into the latex compound (before addition of **TUBALL™ LATEX H_2O**).
	Dilute **TUBALL™ LATEX H_2O** with DI water to 0.2 or 0.1% before use.
	Make sure that diluted **TUBALL™ LATEX H_2O** is used as soon as it is prepared.
	Increase rotational speed to 80–100 rpm.
Viscosity increase of latex compound	Remove/reduce the thixotropic agent.
	In case of a resistivity level much lower than required, it is possible to decrease the dosage of **TUBALL™ LATEX H_2O** to decrease viscosity.
	Use maturated latex compound as soon as it is prepared.

WARRANTIES AND DISCLAIMER

The Products correspond to the chemical composition indicated in the Technical Data Sheet and the Safety Data Sheet. The information contained in this document (Information) is based on trials carried out by OCSiAl and may contain inaccuracies or errors that could cause injury, loss or damage.

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CONTACT INFORMATION

ASIA

KOREA
11F, 254-8 Gongdeok-dong, Mapo-gu, Seoul 04212, Korea
+82 32 260 0407
asiapacific@ocsial.com

HONG KONG
Room 1102, 11/F, Lippo Sun Plaza, 28, Canton Road, Tsim Sha Tsui, Kowloon, Hong Kong
+852 3575 3946

CHINA
#2004, 20th floor, Tower B, Da Chong Business Centre, Yue Hai Street, Nanshan District, Shenzhen, Guangdong, China
+86 755 867 00059

Ground floor, Unit 4, Building 7, No.160, Basheng Road, Pudong district, Shanghai, China
+86 135 9012 5295

china@ocsial.com

JAPAN
Tokyo, Japan
070-1421-0331
japan@ocsial.com

INDIA
Vimal intertrade PVT Ltd,
Shivam centrium,
Sahar road, Koldongri,
Andheri East, Mumbai,
400 069, India
+ 91 22 6288 4200
india@ocsial.com

EUROPE

LUXEMBOURG
1 Rue de la Poudrerie, L-3364, Leudelange, Grand-Duché de Luxembourg
+352 27990373
europe@ocsial.com

NORTH & SOUTH AMERICA

USA
950 Taylor Station Road, Suite #W, Gahanna, OH 43230, USA
+1 415 906 5271
usa@ocsial.com