LATEX COMPOUNDS

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DUNLOP LATICES FOR DIPPING & MOULDING

INTRODUCTION

The properties of rubber latex make it an extremely versatile raw material for dipping and moulding processes. The ability of the rubber particles to coalesce and produce a coherent polymer film that is impermeable to water and air makes latex suitable for an extremely wide variety of products. Articles manufactured from latex exhibit better ageing characteristics, higher strength and greater solvent resistance than those manufactured directly from dry rubber.

As with dry rubber compounding vulcanisation of the rubber is essential. There are two ways of producing a vulcanised latex film - one is by curing the latex in the liquid state. The material is then called prevulcanised latex.

The alternative method is to incorporate the vulcanising ingredients into the latex and to heat and thereby cure the latex film after it has been deposited and dried. This type of compound latex is called vulcanising latex.

Prevulcanised latices are easy to handle and have a long storage life. Having deposited a film of latex rubber by the various methods available, only drying is required to obtain a suitable product.

Vulcanising latex on the other hand has a limited shelf life and the rubber deposited from latex must be heated at high temperature to bring about vulcanisation after drying. Vulcanising latex, is however, cheaper to produce than prevulcanised latex and has other important advantages such as better filler acceptance, improved tensile strength and tear resistance.

Precautions in using Latex

It is essential that contact with copper, manganese or cobalt, or alloys of these metals should be avoided, as even small traces will cause rapid ageing of the latex when it has been dried and cured, due to oxidative degradation.

Latex should be stored within the temperature range of 5^{o} to 20^{o}C, as freezing will cause coagulation and high temperatures tend to produce stability problems.

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DIPPING

Basically the dipping process is the transfer of a rubber film onto a "former" of the desired shape. Balloons, surgical sundries, gloves, fountain pen sacs, bottle teats, toys, rubber shoes and boots may all be produced by dipping. It is possible to produce thin articles merely by straight dipping, but a coagulant is usually employed to give a thicker build up of latex.

Dipping compounds are available in various types and colours to meet individual manufacturer's needs and finished goods can be decorated in a number of ways.

EQUIPMENT

Ovens

Oven interiors should be made of non-corrosive material and should be lagged to conserve heat. The temperature range should be between $0^{o}C$ and $80^{o}C$ for prevulcanised latices or $0^{o}C$ and $140^{o}C$ if vulcanising latices are to be used.

In both drying and vulcanising ovens, warm air circulation is important in keeping moisture build up and curing or drying times to a minimum, exhaust fans should therefore be fitted to ovens.

Most companies producing metal fabrications will manufacture ovens to individual customers' requirements.

Dipping Tanks

These may be constructed of porcelain, enamelled iron, stainless steel or polyester glass fibre and lids should be constructed from the same materials. These are normally obtainable from sheet metal companies or those specialising in the materials mentioned.

Formers

"Formers" may be constructed from aluminium, stainless steel, chromium plated metal, porcelain, glass or thermosetting plastic. All "formers" should be clean and free from grease or acid before use.

Porcelain "formers" are available from companies in the 'Potteries' area (Stoke-on-Trent). Aluminium "formers" can be made to specification by most aluminium casting companies.

Dipping Machines

These may be hand operated for the smaller manufacturer, or automatic for larger scale production. Electro-hydraulically operated machines can be supplied by Diptech, 29 Lansdown, Stroud, Gloucestershire GL5 1BG. Telephone 01453 752597/752653.

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DIPPING - EQUIPMENT (continued)

Coagulants

1 General Purpose - 20% calcium nitrate solution in methanol.
20% acetic or formic acid solution in methanol.
Acetic or formic acid is available from most chemical manufacturers. Water may be added to the methanol when required, especially where used with acetic for formic acid, an equal volume of water and methanol being mixed. This will give a thicker latex build up, but will have a slower flash off or crystallising time, thereby necessitating a longer waiting period between coagulant dip and the subsequent latex dip.

2 A close control of coagulant concentrations is necessary if constant results are to be obtained.

If laboratory facilities are available, a method of testing the concentration of the batch can be supplied on demand. If these facilities are not available, then bath imperfections will be noted with experience.

As a general guide, if the bath is too weak, the dipping process will be slowed down and the latex pick up will be low. When the bath is too concentrated the latex will slow gross imperfections or acid marks and runs will be noticed.

Dipping Techniques

Dipping techniques vary slightly according to the article in production, but the process detailed below is generally representative and would be suitable for the production of thicker transparent articles, such as catheters, soothers and bottle teats.

1 Warm, clean "formers" are slowly immersed into the dipping latex, to avoid trapping air bubbles, then withdrawn at a uniform slow speed. Ideally, the "formers" should be withdrawn at a speed slightly slower than that at which the latex runs from the "formers".

2 Invert the "formers" (this should be done after every single dip as it assists in minimising blobs on the end of the "formers") before drying. Three minutes at between 60^{o} and 70^{o}C is normally suitable.

3 The warm "formers" coated with latex are then dipped into the coagulant and withdrawn slowly.

4 Allow solvent to evaporate from coagulant before immersing "formers" into second dip, then leave in the latex for 60 seconds approximately. The "formers" should then be withdrawn slowly, inverted and dried for approximately 20 minutes at 60^{oC} to 70^{o}C. (Brand marking of items such as bottle teats can now be conveniently carried out. Printing ink manufacturers will advise on the correct type of ink).

5 Repeat Coagulant Dip as (3).

6 Repeat Latex Dip as (4).

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DIPPING - EQUIPMENT (continued)

7 If teats and soothers with a rolled edge are being produced, these should now be partially dried before the bead is rolled, then finish drying for ten minutes at between 60° and 70°C. The addition of up to 20% of an unvulcanised latex will greatly assist in improving the tack for beading. Further details of latex for beading will be supplied on demand.

8 Loosen articles from "formers" under water (preferably warm) before stripping.

9 Articles should then be leached for approximately 20 hours in cold water containing 0.2% teepol or stergene in order to remove any traces or coagulant or auxillary rubber chemicals from the surface. Transparency and water resistance are also improved through this process.

10 After leaching, the articles should be dried at between 60° and 70°C until transparent. This should take approximately 24 hours. It is essential that drying temperatures should not be raised above 80°C in an effort to speed drying as this is liable to burn or discolour the finished article.

11 Immerse in a properly constructed chlorinating bath, such as those used in a Water Works, at a concentration of 168 PPM chlorine for between three and four minutes, then wash thoroughly with water before replacing in the drying oven for a further ten minutes at 60° to 70°C. This detacks the article, but if preferred this can be achieved by washing in a very dilute silicone emulsion. Silicone manufacturers will advise on suitable types of silicone.

12 The hole in teats is pierced using a heated platinum wire.

The latex build up on the "formers" during dipping will vary according to the temperature and on the length of dwell in the latex - this dwell time can only be determined by experience. In very warm conditions, ammonia loss can be compensated by the addition of a 10% ammonia solution in soft water. If facilities exist for testing the alkalinity of the latex, a figure of about 0.5 gms, NH_3 per 100 gms, of latex should be maintained. The achievement of consistent thickness is greatly facilitated by the use of dipping tanks that are water jacketed and thermostatically controlled (see Fig 1 on Page 5).

When dipping tanks are topped up or filled with latex, it should always be sieved through damp muslin and the tanks should then be covered and left overnight to allow air bubbles to rise to the surface where they can easily be skimmed off. Surface skin on the latex may be removed by skimming, but this may be greatly decreased by a very slow moving mechanical stirrer at the bottom of the tank.

The procedure and equipment for dipping in coloured latex is basically the same as for transparent articles.

For increased production, continuous tunnel driers are more practical than single ovens.

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DIPPING - EQUIPMENT (continued)

There are three basic variations for dipping such articles as balloons, pen sacs etc. These are:

1 Straight dips without coagulant drying between dips, beading where necessary, washing in water at 50°C, drying, detacking and then stripping. This method is suitable for surgical sundries and similar items.

2 Dip the warm "formers" into general purpose calcium coagulant, allow solvent to evaporate, straight dip in latex, and dry. Bead if required, wash in water at 50°C, dry, detack and then strip. This affords a slightly thicker build up than Method 1. This method is very suitable for balloons.

3 Dip "formers" in latex, dry, dip in general purpose coagulant, allow for evaporation, dip in latex, bead if required, dry, detack and then strip. This process provided the thickest build up and would be suitable for the production of items such as gloves, high quality balloons etc.

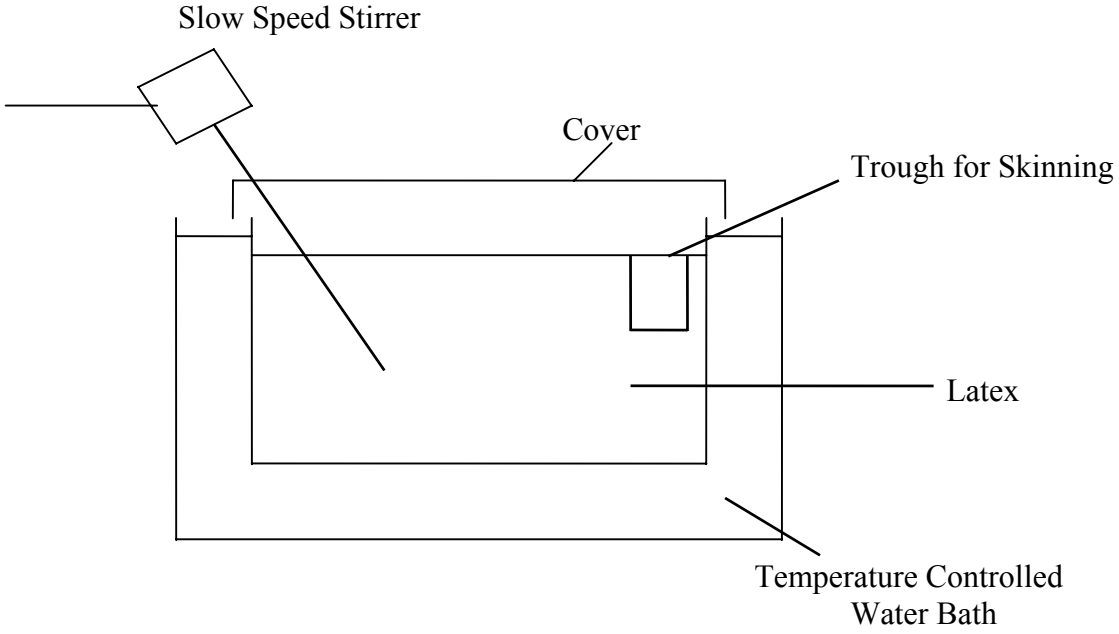
Whichever dipping process is used, the basic principles still apply. Dips should be slow and even, "formers" should be inverted after dipping and should always be warm and free from grease, dirt or acid. Oven temperatures should be between 60° and 70°C.

Beading may be carried out by hand or by rotating brushes in a very dilute silicone emulsion before tumbling in a warm air oven for final drying.

Where semi-transparent straight dips are employed, lycopodium powder may be used for detacking.

Pin hole detection methods are normally developed by individual manufacturers to suit their own production lines. Electronic and compressed air devices have been found to give general satisfaction.

FIGURE ONE
Cross section of Thermostatically Controlled Dipping Tank.



MOULDING

There are two main methods of moulding with latex compounds. These are Dip Moulding where plaster "formers" are dipped into the latex, and Cast Moulding where latex is poured into a plaster mould.

Dip Moulding is especially suitable for the production of rubber moulds in which articles may be cast in plaster or cold setting resins.

Cast Moulding is ideal for the production of soft rubber toys and similar items.

A coat of latex when dried, faithfully reproduces a permanent indentation or marking of the mould surface, therefore a considerable amount of surface detail can be successfully incorporated in products manufactured by these methods.

Latex moulding compounds are extensively used for marking toys, exhibition display models, theatrical props etc.

Dunlop latex compounds are available in various degrees of hardness or flexibility to meet individual manufacturers requirements.

EQUIPMENT

Ovens

As for Dipping.

Moulds

These are made from Plaster of Paris and where necessary are made in a number of sections to ease the removal of the casting, although the flexibility of the cast product does permit the accommodation of a certain amount of under-cutting without the necessity for a further division in the mould. Joint faces between each section should be smooth and flush fitting to minimise flash and seam marks.

It is important that the correct type of plaster should be used. The plaster should be mixed in the ratio of two parts of plaster to one of water and care should be taken during mixing to avoid aeration.

When making a mould an empty box or container should be used. This must be sufficiently larger than the object to be moulded in order to obtain the required mould wall thickness. This container should be half filled with the mixed plaster slurry and the pattern should then be immersed half-way in this wet plaster, care being taken not to entrap air beneath the pattern. The plaster should be left to set and then small sections or holes should be cut in the joint faces to form locating keys or lugs. This face should then be coated with a soft soap solution and left to dry for 15 minutes. The container should then be filled to the top with freshly mixed plaster, care again should be taken to ensure that no air bubbles are trapped. Allow to set and carefully open the mould to remove the pattern.

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MOULDING - EQUIPMENT (continued)

"Formers"

These are cast from plaster of the same type as that used for moulds. They may be prepared from a rubber master mould and may be internally reinforced where necessary by metal strips, especially if vacuum lines are to be fitted to the inside of the "formers" (see Dip Moulding Techniques). Plaster moulds and "formers" may be used up to 50 times, dependent on care in use.

Dipping Tanks

These are identical to those described in latex dipping equipment (see Page 2).

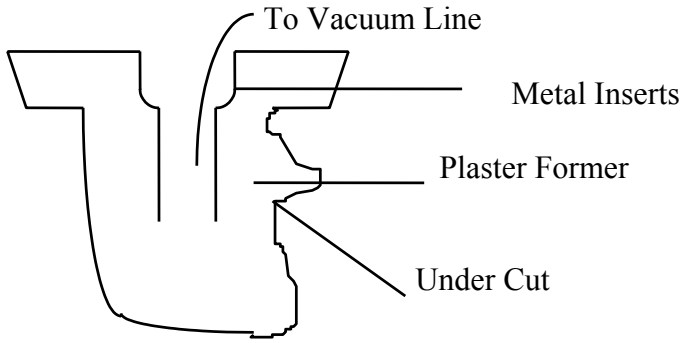
GENERAL MOULDING TECHNIQUES

Dip Moulding

1 Ensure that the plaster "formers" are thoroughly dry and free from dirt, grease or any foreign matter.
2 Immerse the plaster "formers" into the latex slowly and evenly to avoid entrapping air bubbles, then allow to dwell until a latex film of suitable thickness is obtained. The length of dwell will depend upon the porosity of the plaster and the size of the casting, but as a general guide times of between 7 and 15 minutes should prove suitable.
3 Dry the rubber mould on its "former" in a convection oven at a temperature of between 65°C and 80°C. The drying period will be between 30 and 60 minutes, depending upon thickness of rubber deposited on the "formers".
4 Moulds should be detacked with talc or a 5% soap solution and then stripped from their "formers". The flexibility of Dunlop Latex Compounds enables the moulds to be stripped from the "formers" without fear of splitting, providing the moulds have been correctly dried. After stripping, the interior of the mould should be detacked in the same manner as the exterior.

NB: In the case of plaster "formers" which have deep undercuts, low vacuum drains may be incorporated. This will greatly assist in preventing air trapping.

FIGURE 2



Latex Compounds should always be sieved when filling dipping tanks and the tanks should then be covered and left overnight to allow air bubbles to rise to the surface, where they can be easily skimmed off.

Cast Moulding

1 Ensure that plaster moulds are thoroughly dry and free from foreign matter.

2 Slowly pour the latex compound into the mould, taking care not to entrap air. Allow to stand for about 10-15 minutes, topping up with fresh latex as the level drops until the final wall thickness required is obtained.

3 Carefully empty out the excess latex (this may be re-used) and allow the mould to drain for a few minutes to reduce the risk of irregular film thickness. The exact length of time required to achieve a particular wall thickness with any given mould is best established by experiment.

4 Dry the mould and the casting at between 50^{o} and 70^{o}C, until easy distortion, free removal of the casting from the plaster mould is possible. This drying time will vary according to the size and shape of the casting, but will normally be no less than 20 minutes.

5 The cast rubber article must be returned to the oven after removal from the mould for completion of drying at approximately 70^{o}C. When vulcanising latex compound has been used the drying should then be followed by vulcanising in an oven at a temperature between 110^{o} and 130^{o}C. Vulcanisation times vary according to the thickness of the casting, but will normally be between 10 and 30 minutes.

6 Dried and cured articles are buffed to remove flash marks and can then be coloured or lacquered as required. Surface colours are applied by spray or brush and should be as flexible as the rubber article. Plasticated or cellulose finishes have proved adequate for fairly rigid figures. Finishes of a more flexible nature are required for softer products and paints based on neoprene are suggested. These are made by several manufacturers.

TEMPERATURES

All times and temperatures quoted are intended as a general guide and a different climatic condition or using different processes, slight alterations to the recommended times and temperatures may prove satisfactory.

AVAILABILITY OF EQUIPMENT AND MATERIALS

The names and addresses of manufacturers and suppliers of equipment and materials have been included to assist customers with initial enquiries. We are, naturally, unable to guarantee either the quality or the availability of their products, though the companies mentioned have been found to give general satisfaction to our customers. In most instances there are a number of alternative sources of supply.