

Drying Requirements in Lac Processing and Scope of Improvement

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ABSTRACT

Lac is a natural resin having wide applications ranging from surface coating to synthesis of fine chemicals. The basic raw material for lac industry is stick lac, which is used for making seed lac, shellac, bleached lac and other value added products. Drying is an important unit operation in preparation of these semi-refined and finished products. The most important parameter in drying of lac is drying temperature, which should be kept below its softening temperature (40-50°C) during drying operation. The various lac processing units fall into two categories, namely non-mechanized and mechanized units. In non-mechanized units drying is carried out either in mild sun-light or in shade manually employing labour; whereas in mechanized units, the drying operation is mechanized to some extent for seed lac, but for products like bleached lac and other value added products, proper drying is still a tough task. The paper discusses the drying requirements for different lac products like stick lac, seed lac, bleached lac, aleuritic acid, lac dye and extent of mechanization of this operation and scope of improvement in it.

INTRODUCTION

Lac is a natural resin of insect origin, which is non-toxic, biodegradable, and its sources are renewable. The basic raw material for lac industry is stick lac, which is obtained by scraping lac encrustation deposited on twigs of certain host trees like *kusum*, *palas* and *ber*. Stick lac, apart from lac resin and its associated dye (erythrolaccin), contains water-soluble lac dye (laccic acid), wax and some impurities like insect debris, sand and woody material. Removing lac dye and impurities as far as possible by crushing, sieving, winnowing, washing and drying yields the semi-refined product known as seed lac which is used for manufacture of shellac and other value added products. Lac has a wide range of applications in the areas such as surface coating, electrical insulation, adhesives, pharmaceuticals and bioactive compounds, synthesis of fine chemicals and control release formulations (Anon., 1998).

India is a major producer of lac. The lac industry is a cottage industry and various processes are still largely carried out as in the same way as it was

done centuries ago. However, the large factories have been mechanized to some extent for primary cleaning process. Various lac processing units fall into two groups, namely non-mechanized and mechanized units. Non-mechanized units manufacture seed lac and hand made shellac and are scattered all over the state of West Bengal, Jharkhand, Orissa and Madhya Pradesh.

Among different unit operations in lac processing, drying is an important operation. The temperature and moisture content are important parameters in drying of lac products as proper drying improves the quality of product and also enhances its keeping quality. The temperature of lac in drying operation needs to be maintained below softening temperature of lac, which is between 40 to 50°C. The paper discusses the drying requirement for different lac products like stick lac, seed lac, bleached lac, aleuritic acid, lac dye and scope of mechanization for improvement in this operation.

Stick LAC

Lac is collected by cutting down the lac bearing twigs of host trees either week before larval emergence,

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which is known as *ari* or after larval emergence when it is known as *phunki*. Lac encrustations are separated from twigs either breaking by hand or scraping with a knife or sickle. Lac thus gathered is known as stick lac and it is in this form the cultivator brings it to the market for sale either to manufacturer or to their agents.

Ari stick lac may contain 10-20% of moisture; most of it is in the insect cell. In this state it is soft and blocky tending to coalesce into solid lump if subjected to any heat or pressure. Stick lac is often spread out on floor to dry for a week in cool place and aerated by raking or turning over, to dry the lac sufficiently to enable it for packing and transport to manufacturing centers. The hot monsoon season is particularly difficult time and blocked lac is sometimes received with sticks and insect remaining fused into a solid lump. For drying in adverse weather condition, specially during rainy season, in which, there is less sunshine and high humidity, a suitable drier is required which will also minimize the time needed in preparing material for transportation.

Seed LAC

The making of seed lac involves five major unit operations, namely crushing, washing, drying, winnowing and grading. Stick lac after crushing, is sieved through one large (8-12 mesh) and one fine (30-40 mesh) size wire net. The choice of exact mesh number depends on the quality of lac. In small factories sieving is carried out manually and in big or medium sized factories with the help of machines. The bigger clods are put into crusher again for reducing their size. Some different process is followed in small factories in which the first step is to clean and roughly grade the stick lac. After crushing, the lac is subjected to the washing process. In most of the small or cottage type industries washing is carried out manually in cup shaped stone vats whereas, medium and large sized factories employ washing barrel for performing this operation. After washing the stick lac either in vat or with washing barrel, the washed lac is kept in basket to drain out water as much as possible. The washed seed lac is dried by spreading it on a cement courtyard preferably in the shade. The wet seed lac is spread in very thin layer and turned over from time to time with a wooden rake

and hoe (Prasad *et al.* 2000). The drying may take from about an hour to several hours or even days depending upon the weather.

In the mechanized seed lac plant, the blocked lumps of stick lac are reduced to size of about 75 mm, which is then fed into series of secondary crusher for reducing the size to 8 mesh. It is then passed through vibrating screen and then through another crusher reducing it to two different fractions namely, 40 mesh and 12 mesh. In this grain size, seed lac is washed and dried. In the plants, seed lac is dried using current of hot air carefully regulated to avoid softening of lac.

For mechanizing the drying process, it will be economical to first drain the water as effectively as possible before subjecting the lac to any drying process. In an investigation carried out at IINRG regarding use of centrifuge before drying, the washed seed lac drained in conventional way was found to contain 36.40% of water/moisture and when centrifuged for 10 minutes, the moisture content dropped to 11.3% and thereafter, the drop was comparatively lower.

The extent to which a rotary drier can be used for drying seed lac was also investigated. A laboratory scale continuous drier having length 2.5 m and diameter 0.3 m with slope of bed as 0.0625 m/m. length of drier was used for this purpose. The feed rate of seed lac in the drier was from 8.7 to 34.5 kg/h. It was found that when the inlet temperature of air was as high as 57°C, the exit material temperature remained 40°C. Dehumidification of air was not necessary due to higher allowable temperature of air in spite of limiting temperature (40°C) of the material. The drier was capable of bringing down moisture content of centrifuged seed lac to around 2%

In most of the non-mechanized and small factories, drying of seed lac is still carried out by spreading it on the floor without any use of drying machines. In rainy season when humidity is high, it is difficult to dry washed seed lac and for drying in such an adverse weather condition, suitable drier is required.

Bleached LAC

The process of making bleached lac involves bleaching the lac solution with bleach liquor of specified strength. The solution is then precipitated

with mineral acid, washed and dried to get the bleached lac in the form of coarse white powder. Bleached lac, which is highly valued for its outstanding properties, suffers from one important defect i.e. its poor keeping quality in dry state. After washing, it is advantageous to keep the bleached lac submerged in water overnight before filtering off and drying. It is advised to use a centrifuge before drying for removing moisture from precipitated bleached lac. The moisture content of centrifuged bleached lac depends upon the temperature to which the lac has been exposed. Lac precipitated at 20°C and further untreated retains moisture as much as 200% on the dry basis. If, however before centrifuging, the precipitated lac is warmed up to 40°C for 10 minutes only 40% moisture is retained in the centrifuged material. Further drying in oven for 18 h at 40±2°C was found sufficient for bringing down moisture content from 40% to 2-3%.

A little raking in the initial stage of drying has been found beneficial as it avoids possibility of lump formation. The colour of dried material appears to be a little creamy as compared with that of air dried material, but the colour index remains unaffected. The most important factor in drying of bleached lac is the temperature. The upper limit is 42°C because exposure even for a short period above 45°C results in darkening of colour and reduction in clarity of alcoholic solution. They prefer the drying to be carried out as a continuous process by means of hot air, using either a counter current or a parallel current system. Horizontal vibratory screens, in tunnel type drier using an upward current of hot air are useful, tray drier, whether working under vacuum or ordinary pressure has been discontinued. In large factories, overseas, the precipitated bleached lac is heated up with water when it melts and then removed as Taffy, washed, allowed cooling and crushed and then dried in vacuum or rotary driers. Thus, drying of bleached lac is an important unit operation in mechanized plant as it affects the keeping quality of bleached lac. Mechanization of this unit operation is also important in small plants as it removes dependence on air-drying especially in rainy season.

Aleuritic Acid

Aleuritic acid (9, 10, 16-Trihydroxyhexadecanoic acid) is a major constituent acid of lac resin and is

present in the lac resin to an extent of 35%. It is a starting material for the synthesis of various products like isoambrettolide, civetone and exaltone, which are used as fixative in perfumery industry. It may be used for preparing other useful compound like insect sex pheromones, plant growth regulator, stabilizers (metallic salt), insect repellants and nematicides. For the preparation of aleuritic acid, seed lac is subjected to alkaline hydrolysis and sodium aleurate is obtained, which is filtered, acidified, washed and dried to obtain crude aleuritic acid. This is further purified using ethyl acetate or methanol-water mixture in 15-20% yield by weight of seed lac. The crude aleuritic acid is bleached sometimes to get pure white compound, otherwise its colour may be slightly yellowish. Drying of aleuritic acid is carried out in shade and sun drying is avoided as it may result in darkening of colour.

Lac Dye

Stick lac contains water-soluble dye (laccic acid), commonly known as lac dye. It is secreted by the lac insects along with resin and wax. The dye content in the stick lac is estimated to be 1% by weight of stick lac. During the washing of stick lac this lac dye goes with wash water and it can be recovered as by-product through chemical process. Lac dye is used for dyeing of wool and silk fabrics. Since it is non-toxic, it is also being used as food colouring material. It is recovered from wash water of seed lac by acidification, lime treatment, acid treatment, filtration, washing and drying (yield approx. 0.5% on the weight of sticklac, dye content 70-80% depending on the quality and age of stick lac). The technical grade dye is further purified by dissolving it in mild alkali, filtering the insoluble, acidifying the filtrate and finally keeping it for 7 days for crystallization. The crystallized dye is filtered, washed and dried.

Drying of lac dye is an important aspect in dye production. To maintain its desired colour, drying should be carried out below 40°C as drying at higher temperature results in blackening and darkening of colour, which ultimately decreases the solubility of lac dye.

Conclusion

It is evident from the study that, proper drying in lac processing is important and temperature of

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operation is an important parameter as drying at lower temperature (below 40°C) improves the keeping quality of lac products. In most of the non-mechanized and small and medium sized mechanized factories drying of stick lac, seed lac and other value added products is still carried out by spreading on floor or in tray which takes more time and needs mechanization. For value added products like bleached lac, Aleuritic acid and lac dye,

drying at lower temperature is needed for retaining colour and improving their keeping qualities.

References

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