Rosin size in paper industry

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Rosin size constitutes one of the many important factors in the day-to-day running of a paper or paper board mill. In essence sizing can be defined as such treatment by a chemical other than bleach, fillers, dyes, pigments etc. either by addition to the furnish or subsequent to web formation whereby *the resistance to the transudation or absorption of liquids by the finished* board or paper is increased. Its importance can really be understood by the ill effects arising out of its incorrect application which sometimes may go out of proportions as the paper or board comes out from the machine.

BACKGROUND/HISTORY

For the basic concept of the phenomenon we remain indebted to Moritz Illig, who in 1807 revealed that some resistance to water could be imparted to paper by mixing a suitable size prepared from rosin in the paper stock in the beater or vat and thereafter precipitating it on the fibres. This was a progress of utmost importance, as it appeared to be much superior to the then existing method of animal sizing with glue or gelatine, which could be applied only to the finished paper and as such is a case of surface sizing. It is possible that Illig took rosin to be a water resistant material which could be solubilised with the aid of alkali and then reprecipitated by acid. However, he recommended the use of alum as precipitant for practical purposes. May be, that the underlying principle of the effect was not altogether clear at that time as he beleived acid to be equally useful for precipitation. Till then, throughout the last two centuries substantial changes and improvement have occured to paper manufacture, yet rosin based size has retained its old vital role despite the introduction of several synthetic and other sizes to replace it either wholly or partly.

MATERIALS FOR ROSIN SIZE

Rosin size basically is constituted with rosin, a solubilising alkali and a precipitant. Rosin is a forest based product from Pine trees and chiefly two types are defined—gum rosin and wood rosin. When the living pine tree is tapped, a sticky mixture, called Oleo Resin is exuded from the wound and distillation of it yields gum rosin coming in different colour grades and gum turpentine. Wood rosin is obtained by solvent extraction of Pine stumps which have been in the ground for a number of years after the felling of the tree. However, a third variety of rosin called tall oil rosin is obtained as a bye-product of pulping pine wood by Kraft process. Rosin as such, is not a pure substance, with approximately 90% of it being resin acids and the rest neutrals. In the making of sizes advantages is taken of its acidity. For solubilising it in water the most commonly used alkalis are Caustic Soda and Soda Ash Other alkalis like Sodium Silicate, Amonia etc. have been considered so far but wi hout much commercial success. Alum has proved to be the best precipitant for the papermaker However, papermaker's alum is not the usual double salt of aluminium sulphate and alkali sulphate; it is only hydrated aluminium sulphate represented as $Al_2(SO_4)_3$, 18 H_2O. For the best grades of paper it is required to be free from iron.

TYPES OF ROSIN SIZES

In the main, there are two types of rosin sizes manufactured from gum or wood rosin ranging from the darkest to the palest grades, viz. (I) Neutral size and (II) Free rosin size. They vary from those in which the rosin is fully saponified by boiling with an excess of alkali for the former one, through emulsifiable pastes cooked with soda ash or caustic soda to the latter type, when upto 90% of the rosin can be present as a colloidal dispersion. The use of neutral rosin size in the paste form has become more or less obsolete with most mills switching over to buying it as a prepared dry powder size, of course, with its accompanying handling problems. Again with the free rosin size, products having more than 50% free rosin content is seldom produced by the cooking process.

In other countries, the recent trend has been a change-over to prepared sizes in preference to millmade size processes. The reason could be traced

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to the increasing complexity in handling rosin, essentially a natural raw material, with distinctly variable properties differing with origin and other factors. Manufacturing processes based on experiences in rosin chemistry with the added benefits of full-time technical control, which a specialised rosin factory may afford, can prepare a product of uniform quality. This way, for the papermakers, at least one of the many headaches encountered in day-to-day operation could possibly be reduced.

More recent developments in the field of sizing have been the so-called fortified sizes wherein rosin is combined chemically with a modifier for all-round improvement before being reacted with alkalis. By using this, same sizing efficiency is possible with reduced size consumption and this fact has been established in many mills with almost all types of processes. A worthwhile saving in size consumption, in some cases upto 50%, has often been found. The actual extent, of course, is dependent on the individual demands and circumstances. Alternatively, the ability of a fortified size to give hard sizing at size furnishes, when, with ordinary type sizes, machine operation is adversely affected, proved to be a great asset.

Another outcome of basic researches in rosin chemistry has been the introduction of a sizing based on hydrogenated rosin for such speciality papers requiring considerable ageing characteristics. Here particularly, rosin is rendered more inert to changes as against the normal reactivity of rosin.

RAW MALERIAL HANDLING

Operating with mill-made sizes amount to dealing several chemicals, viz. rosin, soda ash, caustic soda etc. This size is then made according to the type to be used-either neutral/saponified or free-rosin/emulsion. In the former case, the resultant product is further reduced to 2 to 5% solid content, whereas with the latter customarily dilution to approximately 20% solid strength is attained and used as such.

The use of a prepared size in the first place eliminates the initial part of the process. Moreover, the mill is then in a position to be able to use a product of uniform and known characteristics. A standard size once tried and tested under particular operating conditions should continue to provide the same efficiency, other factors remaining equal.

The sizing ingredients may be added to the stock at any point between the beater and the paper machine head box, but in most mills rosin size, alum and other special sizing compounds are added in the beater. There are several conflcting ideas as to what should be timing for size addition to the beater. Old school of thought, believing in using thick sizes as a contrast to modern usage of diluted one, claims a dispersion in the stock is achieved by adding the size as soon as the fibrous stock has been furnished. Modern practice is to add the size to the stock just long enough to get thorough mixing before the alum is added.

Alum is usually added to the stock after the rosin size allowing time for uniform size dispersion before alum coagulates it. However, cases are there when alum is to be used before size. For example, with hard water it is fair enough that the pH is adjusted to 7.0 with alum before size addition. Again with the stock in the beater above 100 °F, it is advantageous to slightly acidify with alum and then add size to prevent coagulation of the stocky size particles.

AMOUNT OF SIZE AND ALUM REQUIRED

The amount of rosin size required to obtain a desired sizing effect varies with the furnish or intended paper grade and, of course, the mill condition. Moreover, the quality of the size-whether regular or fortified is also to be considered. Again, some pulps are easier to size than others. It is generally observed that unbleached kraft pulps has a greater size affinity than most others and in decreasing order the various pulps may be listed as follows:

1) Unbleached Kraft pulp
2) Brown steamed ground wood
3) Bleached Kraft pulp
4) Unbleached sulphite pulp
5) Bleached sulphite pulp
6) Rope
7) White ground wood
8) Esparto
9) Rag
10) Brown and white groundwood from greenwood.

Quality or the intended grade of paper also constitutes a function in deciding the extent of sizing to be given and typical percentages with regular size is shown in the following table:

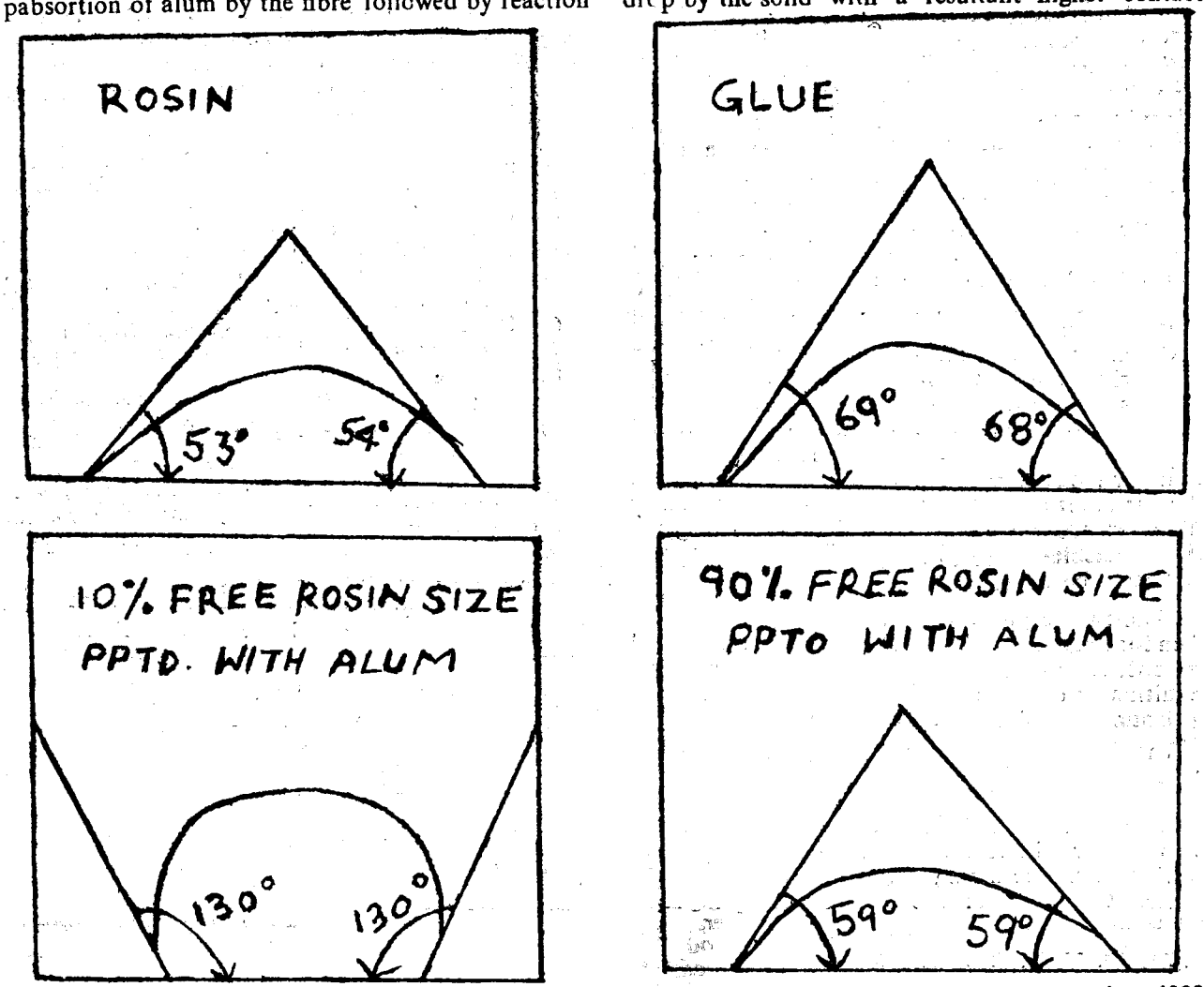
Grade	Percentage	Grade	Percentage
Newsprint	0—0.5	Wrapping	1.0—3.0
Book	0—2.0	Patent-coated board	1.0 – 2.5
Writing	1.5—3.0	Wallboard	2.0—3.0
Rags	0.6—3.0	Container board	1.0—2.0
Kraft	0.5—3.0	Blueprint	2.0—3.0

As regards the quantity of alum to be used, theoretically 0.3 parts would be required for 1 part of rosin to get converted to aluminium resinate. However, in practice it is pretty common to use an alum to size ratio varying from 1 : 1 to as high as 3 : 1. The free rosin content in the size, local mill conditions, pH obtainable in the stock before and after alum addition, and the hardness of water are among the various controlling factors in the determination of papermaker's alum requirement.

ROSIN RETENTION AND THEORY OF SIZING :

Despite the established efficacy of the sizing phenomenon, an explanation with universal recognition is yet to be propounded as to how rosin is retained by the fibres. From time to time it has been diversely attributed to a physico-chemical combination of rosin with alum and fibres, to pabsortion of alum by the fibre followed by reaction with rosin, to an electrostatic attraction of the negatively charged fibres, the positively charged alum hydroxide and the negatively charged rosin; to a mechanical filtration process by which the rosin is retained like fillers. It is now agreed that the electrostatic theory enjoys a wider acceptance, though all others also seem to have at least some modicum of truth.

As regards the theory of sizing action, the same can well be explained with the help of the contact angle theory expounded by Cobb and Lowe. When a drop of a liquid is placed on a solid, the wetting characteristics of former with respect to the solid surface determines the angle at which the drop comes to a rest. The higher the wetting, the more is the flattening of the dropto the solid surface, and this indicates a lower angle of contact. A liquid which wets poorly results in repelling of the drop by the solid with a resultant higher contact



angle. The same can by shown be the following figures :

It is clearly seen that a 10% free rosin size shows a much better sizing efficiency as compared against simple rosin and a 90% free rosin size.

ROSIN SIZE AND INDIAN SCENE

In India Pine trees for rosin production are distributed along the northern Himalayan region and all the processing units are situated in those places only. Although the rosin requirement in paper industry is minute, the same was put at between 10,000 to 12,000 tonnes for 1980 alone for a projected production of 3 million tonnes figure for various paper materials in India This was against an actual consumption of 4,000 tonnes of rosin in 1970 for a corresponding 0.6 million tonnes of paper and board productiou and represents an almost three-fold increase in a span of just 10 years by paper industry alone, besides the ever increasing demands from paint, rubber, soap and adhesive industries in the country. Moreover, with a growing awareness for a judicious conservation of natural and forest based resources, possibly rightly so, there is every reason to believe that rosin production in the country at least for some time will remain at its present level of about 30,000 tonnes only, if not a reduction is there. In fact, paper industry itself has already started feeling the pinch of rosin shortage, a situation unlikely to improve in near future. Thus a concerted effort by all the industries concerned with rosin is called for with a view to finding way out before such a poser takes every-one on the wrong side.

As already pointed out in many advanced countries, paper mills have started preferring a prepared size, plain or fortified, to mill-made ones. We, in India, however, may not be finding the idea that much attractive, though of course, materials of uniform quality could reach the factory from a basic industry. The reason could be the great distance in the location of the major Rosin Industries vis-a vis those of the major Paper Mills.

The accompanying transportation, packaging and storage problems are also a high stake in the matter. Under such circumstances some alternatives which will not be confronted with these problems and at the same time not imposing any excess-than-normal financial burden on the paper mills should be looked into vigorously. For its part, the paper industry in the country may try to switch over to such alternatives with a reduced rosin demand and still have the performance of the finished products maintained if not somewhat improved The basic rosin industry holds the key factor introducing these products in the market with purposeful co operation of the former. In fact a serious rational approach with in-field-trials by paper industry may thwart an otherwise bleak outlook of rosin production in the country. Thus, even if the indigenous rosin production falls, the paper industry will not be affected immediately.

From commercial viewpoint, the new products may very much reduce the size consumption ratio and ultimately will not only offset the convension cost, but may result in marginal savings also on account of this particular phenomenon.