are, of course, some very broad and general relations, certain soil types running low in organic matter, while others, such as the Marshall, Portsmouth, and Yazoo series, run consistently high, but all these latter soils are, or were recently, in a more or less swampy condition with a large accumulation of organic matter. The general result is, however, that the variation in the total organic matter in different samples of the same soil type is fully as great as between samples of different types. For instance, the Norfolk fine sandy loam, a pale yellow or gray sandy loam, has from 0.3 to 3.0 per cent. organic matter, while the Porters sandy loam, a grayish yellow sandy loam, and of but little finer texture, contains from 1.0 to 7.7 per cent. organic matter. but the Orangeburg clay, a red loam or clay loam, contains from 0.6 to 3.4 per cent., the Hagerstown clay, also a red clay or clay loam, contains 0.7 to 3.7 per cent., while the Hagerstown loam, a distinctly easier soil to till, and brown or yellow in color, contains 0.5 to 3.1 per cent. organic matter.

For these reasons the Bureau of Soils proposes in the future to omit the determination of the total organic matter as a regular integral part of the mechanical analysis of a soil, except in special cases when it is obviously of importance in defining a type. It will, of course, continue to make such determinations in individual areas for the purpose of studying the influence of organic matter on the management of the soil and its crop-producing power, and similar investigations involving more or less local peculiarities within any given type.

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WASHINGTON, D. C.

SIZING PAPER WITH ROSIN SOAPS.

BY MARTIN L. GRIFFIN.

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IT has been the general practice until recent years for papermakers to use an excess of soda-ash or other alkali in saponifying their rosin for size-making. They have been very careful that there should be no free rosin in their size, lest rosin specks should appear in the paper, stick to the rolls and cause other annoyances. The popular belief has been that the alum simply precipitates the rosin and that it was the rosin which sized the paper.

Upon this theory has grown the practice of making what is known as free rosin or acid sizes, containing as much as 40 per cent. free rosin as a dilute emulsion, with the claim that less alum would be required and a greater sizing efficiency secured.

THE AGENCIES WHICH SIZE PAPERS.

There has been very little work done to determine accurately what the real agencies are which size paper. A great deal has been taken for granted. The paper-maker lays great stress on both the size and alum, usually increasing the quantity of alum, if he has any troubles, or if any complaints, imaginary or real, are made. There is some foundation in fact for doing this. Wurster's treatise on "Rosin Alum Sizing," 1878, often quoted, claims that it is the free rosin acids which are the effective sizing agents. He draws this conclusion from the results which he obtained by extracting rosin-sized paper with ether and other solvents and found that the extract was composed almost entirely of free rosin acids, and also found the alumina in the paper, before and after extraction to be practically the same in amount. I agree to some extent with the results which he found, but not with his conclusions. In connection with this statement Cross and Bevan, in their work on "Paper-Making," 1900, feel obliged to give color to the correctness of this view, by saying: "It is well known that cellulose takes up alumina from solutions of the sulphates and chlorides. It is therefore, more than probable that cellulose would decompose the neutral resinate by combining with alumina and the rosin acids." I do not dispute this statement, but I do dispute the application of it to prove that free rosin acids are the prime, effective agents. They also say, that "The addition of hydrated alumina to the neutral rosin size during the later stages of the boiling, is rather to be recommended." This recommendation is more than contradictory to the views of the advocates of acid sizes, since it would make a basic size. They say further, "It has been proposed to use aluminate of soda as the solvent for the rosin, but it is difficult to see any advantage resulting from the practice." This hardly harmonizes with my previous quotation from their book. Under the heading "Auxiliary Sizing Agents" they say "Alumina is precipitated as a gelatinous hydroxide by the interaction of the soda of the rosin size with aluminum sulphate. Passing through the intermediate form of 'resinate' it is no doubt finally fixed as the oxide, and aids in cementing the fibers together and filling the interspaces." No direct sizing power is credited to the part played by alumina. On the preceding page of their book, from which this quotation is taken, they report that the function of the excess of alum so generally used is to decompose the neutral resinate of alumina with liberation of free rosin acid and basic aluminum sulphate, and give a formula showing the reaction. It is not quite clear to me how by the use of rosin soap and alum in excess, we get gelatinous aluminum hydroxide in the one case, and in the other, free rosin acid and basic aluminum sulphate. These reactions cannot be obtained outside of the beating engines as I personally know from experience, and I do not believe the latter takes place in them.

It looks to me as if Cross and Bevan did not feel very positive as to their position and offer no evidence one way or the other to prove what they say. To my mind the base of the precipitating agent has more to do with the sizing of paper than the rosin, as I shall prove.

Having taken up the views of some of our best paper-making chemists, without reference to other published articles in books and trade journals, I will detail my work and views on the subject. For the extraction of the total rosin used in sizing paper, I find that a large proportion can be obtained by extraction with strong alcohol, but not all, until the paper has been treated with dilute acid as hydrochloric acid, for the decomposition of some portion remaining as a resinate. My method is to wet out the sample of paper in weak hydrochloric acid, wash out the acid, dry in the atmosphere, and extract with alcohol. I find that well-sized paper, when given this treatment, is very absorbent, before any of the rosin is removed by extraction. The same paper wet out in water and dried remains sized as originally. This goes to show that the free rosin in the paper under the conditions described is not effective to size it. Again I have on several occasions had stuff prepared in our works with no alum or precipitating agent, and then have diluted it to proper consistency and added a varying amount of sulphuric acid and made hand-made sheets, with the result that the stock was hardened but was only partially sized. I also increased the amount of size to see if the deficiency could not be made up in this way, but the results were still unsatisfactory. To me this is conclusive proof that free rosin in the paper is not the all-sufficient sizing agent, and that there is no foundation in fact whatever for the claims made in behalf of the free rosin sizes, and I do not hesitate to say that where proof has been submitted the evidence has not been conclusive or of the best kind.

I next made hand-made sheets to see what effect a liberal use of alum without sizing would have on the stuff, with the result that the paper was hardened but apparently not sized at all. After the lapse of about five years, I find these samples possibly a trifle more resistant to ink but still very absorbent. The same is true of samples which were made with regular furnish of size and precipitated with sulphuric acid. In suggesting how a computation to determine the amount of alum required for a particular mill should be made, Cross and Bevan refer to the lime-salts natural in the water and residues of the stock as precipitants of the size. The impression is created that they contribute to the sizing of the paper and are a factor in determining the required alum. I shall show that the reverse is true and that they are a drawback to sizing.

Some years ago a prominent manufacturer of alum found it convenient to use a small amount of zinc in connection with the solution of the alumina for the purpose of reducing the iron and thereby masking its presence. Whenever this was discovered by consumers, the manufacturer claimed it had an efficient sizing value.

The time finally came when, if paper could be effectually sized by some of these agencies, I could make good use of them and I determined to investigate them. In addition to the work above reported, I made paper, using as precipitating agents, calcium sulphate and calcium chloride. The resulting pulp was slightly alkaline and the paper was not sized properly, though the samples made with calcium sulphate appeared to a better advantage. I next tried the calcium sulphate, using an excess of sulphuric acid to make the reaction acid. This showed an improvement, though the paper was not well sized. Zinc sulphate was next tried, with the result that the paper was extremely absorbent, and hence the claim of a sizing value for zinc sulphate fails. Lead acetate was also tried, knowing its ability to precipitate organic acids. The paper was very soft and absorbent.

Side by side with these, tests were made with varying amounts of alum showing a marked difference in the degree to which the paper was sized, according as large quantities of alum were used, even though enough had been used to precipitate all the size.

Some aluminum chloride was prepared in the laboratory and used as a precipitant of the size in another test to discover whether the base alumina would assert its character as a sizing agent, when furnished as a chloride. The results were satisfactory and the paper sized.

I next prepared a quantity of freshly precipitated aluminum hydroxide and after having obtained a quantity of prepared stuff from our beaters, containing clay, size, etc., but no alum or other precipitant, I precipitated the size with an excess of sulphuric acid and made sheets which showed some sizing effect. To the same pulp so prepared, I added the precipitated aluminum hydroxide with a marked difference in the results, although the stuff and aluminum hydroxide were only stirred up by hand for two or three minutes. The paper was much harder and better sized.

My last test was to treat paper stuff containing no size or alum with aluminum hydroxide only. The result was that the paper was very much hardened but was not sized at all. The conclusions which we must draw from these experiments are: First, that alum precipitates the size as a resinate effectually and that the paper is sized by the resinate, the rosin and alumina separately, and that the resinate is to a degree broken up by the basic character of the cellulose as claimed by Cross and Bevan, but may not be wholly broken up, depending upon conditions, quantity furnished, etc.

Second, that there is no evidence to support the claim that free rosin will effectually size paper and the arguments for free rosin sizes fail. On this very point Mr. W. C. Ferguson, in this Journal, 16, 155 (1894), states, and very truly, that basic alums are more effectual sizing agents than normal alums because they contain more alumina and part with it to the rosin acids more easily. He recognized the important part played by the alumina as a sizing agent.

Third, we must also conclude that any precipitant having an alkaline base as calcium, lead, zinc, etc., will not size paper even though the rosin is effectually precipitated, and the reason for this would seem to be that on account of their basic character there can be no chemical affinity between them and the basic cellulose hydrates. It is also pretty clear that the cellulose hydrates have not the power to combine directly to the extent of being "sized" with either free rosin acids or aluminum hydroxide, but that when combined as a resinate of aluminum, the size having been beaten into the fibers and precipitated, there is a sufficient breaking-up of the resinate and combination both of the rosin acid and alumina, relatively acid, to combine with the cellulose to effectually size it.

Finally, as a corollary to this proposition, we must conclude that papers whose stuff has been treated with hard waters or to which calcium sulphate has been added as a filler cannot be sized as effectually, for the reason that they precipitate the size before the addition of alum is made, leaving no work as a precipitant for the alum to do. This is found to be true in practice.

MECHANICSVILLE, N. Y.

ON THE PRESENCE OF COTTON-SEED OIL IN LARDS FROM HOGS FED UPON COTTON-SEED MEAL.

BY A. D. EMMETT AND H. S. GRINDLEY.

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HAVING had occasion to make for the Department of Animal Husbandry, of the Experiment Station of the University of Illinois, quantitative determinations of cotton-seed oil in lards rendered from the fat of hogs fed largely upon cotton-seed meal, a more detailed study of the samples was undertaken in order to add, if possible, some information as to whether cotton-seed oil actually existed in the body fat of the animals.

That many of the vegetable oils enter into the make-up of the body fat in some manner or other, there can be but little doubt. Lebedeff,[1] and Henriques and Hansen[2] in feeding linseed cake, Monk[3] in feeding rape oil and the fatty acids from mutton tallow, Lebedeff[4] and Rosenfelt[5] in feeding mutton fat; and Shutt[6] in feeding maize, have shown that the resulting fat differs mate-

[1] *Ztschr. physiol. Chem.*, **6**, 149.
[2] *Thier. Chem. Ber.*, **29**, 68.
[3] *Ibid.*, **14**, 411.
[4] *Ztschr. Physiol. Chem.*, **6**, 149.
[5] *Thier. Chem. Ber.*, **25**, 44.
[6] Canada: Cen. Expt. Sta. Bull., 38.