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Effect of fines on the properties of fibre networks

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Colour pictures only

a)

b)

c)

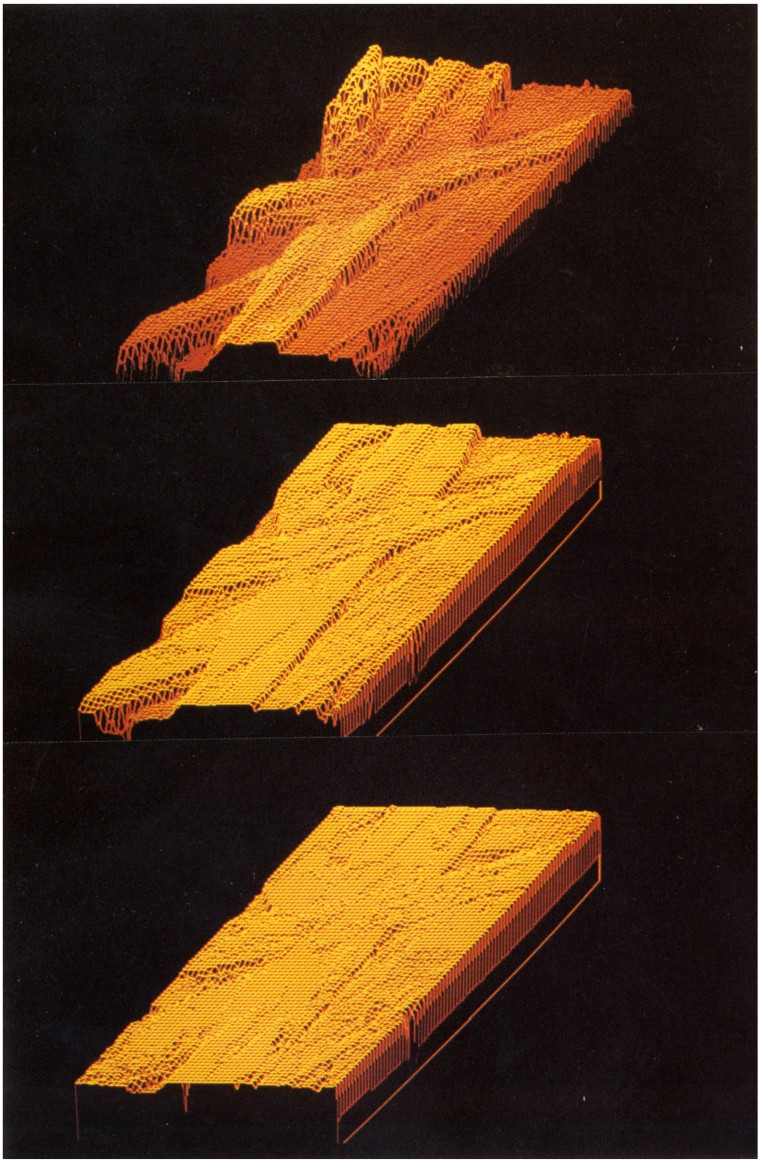

Fig. 20 a) Surface of handsheet made of beaten latewood kraft fibres. The profile is taken from an area of 125 μm by 125 μm. b) Surface of the same sample as in Fig. 20a after first calendering. c) Surface of the same sample as in Fig. 20b after second calendering.

EFFECT OF FINES ON THE PROPERTIES OF FIBRE NETWORKS

E Retaulainen

ERRATA: On p762 of this paper, 'drainage rate' should read 'drainage resistance'.

Prof C T J Dodson, University of Toronto, Canada
It's always worrying for statistical geometry that these fines are lurking in the background with an accusing finger pointing at us, so it is very nice to have this documented so that we can refer to it. Two points, Elias, the first one is a question, but for the second point you might care to look at the conclusion you have on page 762. Your paper is very clear but that conclusion says the opposite of what you mean. When you say drainage rate I think you mean drainage resistance. But this is a trivial typographical error I think.

The technical question was, do you collect the through fraction so that you can estimate the fraction of fines retained?

E Retulainen
Yes, white water recirculation was used so that over 90% of the fines were retained in the handsheets.

J Unbehend, Weyerhaeuser Paper Company, USA
After 20 years of taking fines in and out of sheets and furnishes, I find it is nice to see them getting the attention that they have gotten in your work. One comment I would like to make is that we have found that the fines play an especially important role in TMP, and the same is true for fines from Kraft pulps. In work on TMP fines,

done in conjunction with Renarta Marton while at ESPRI in Syracuse, we found that there was distinct difference in performance if you were to sub-divide the fines into coarser and finer fractions. We even studied the unsettled portion of the fines fraction as well finding that the contribution to the consolidation of the sheet and the optical and physical properties were widely different for these fractions. We also saw this with Kraft fines, both hardwood and softwood, looking at different levels of refining. Most of the work that we did agrees with what you are doing and again, I congratulate you on your work and encourage others working in this area to continue. As Professor Dodson said, consider the fines and their contribution to paper properties from a reinforcement standpoint as well as their function in the overall structural network.

E Retulainen

Thank you. I agree with what you said about this, regarding the quality of fines. I think that the fines fraction is not homogeneous and could be divided into at least three different fractions; a coarse fraction, a middle fraction and a fine fraction.

Dr J R Parker, Messmer Instruments, UK

Most interesting. It doesn't surprise me that TMP fines act as fillers and they don't bond to the fibres, They are mobile and they can fill in the holes between the fibres, something that the kraft fibres might not be able to do but my point is this. I wonder what are the details of the microscopic technique you used for measurement. How did you support the sample when you measured its surface profile. Did you, as in a printing press, press the sample surface you were studying against something like a glass plate to simulate the printing plate, so you had a surface that was under the same conditions as it would be in the press nip. Or did you look at just the free surface in

which case asperities on the surface would stick upwards and in fact bias the roughness histogram you have observed.

E Retulainen

These were free surfaces not under pressure. The handsheet samples were placed on microscope slides and glass coverslips held firmly on top.

J Parker

Sorry, you say that it was not under pressure.

E Retulainen

Yes we calendered the handsheets and then studied them under the microscope looking at exactly the same areas as before calendering. It was not our intention to simulate the pressure that occurs at the surface of the paper when in contact with the printing plate. Our aim was to examine the changes in surface structure at the microscopical level that are induced by calendering treatments, and to see how different fibre networks respond to calendering.

J Parker

Yes, may I explain. There has been quite a history of how to measure roughness. Initial measurements of roughness were made under fairly low pressure and it was found that this did not correspond to the results obtained on printing presses simply because the conditions of measurement did not correspond to the press nip. If you press the sample against a hard surface first so that it flattens as it would flatten against a printing plate and if you can observe the deviations between the printing plate and the surface of the sample, then you can see the surface which you have

to attack and fill up with the ink in order to get a good print. That is my point.

C Soremark, ASSI Kraftliner, Sweden

I have a question regards distinguishing between the primary and secondary fines. Did you start off with a dried pulp and could that be a part of the explanation for the difference in "efficiency" between the two types of fines you mentioned?

E Retulainen

Yes, we used dry lap pulps but I understand that the difference between primary and secondary fines is similar also within never-dried pulps because the primary fines contain parenchyma cells and chunk like material which is not fibrillated. The secondary fines contain more fibrillated material and lamellae so I think that shape is the most important difference.

Dr W Hewertson, CSIRO, Australia

In your list in table 1 most of the effects are positive other than the tear strength and of course drainage. Tear strength appears to be negative with increase of fines whereas later on in figure 5 you show an increase in bonding strength with fines in the Nordman bonding strength. Why do you think you get that strong reduction in tear strength with increasing fines?

E Retulainen

I think that tear strength is strongly dependent on the long fibres, and depending where we are on the tear strength curve, and usually we are on the latter part where the tear strength goes down when we increase bonding. In this case we increase bonding when we

add fines while at the same time we actually decrease the amount of long fibres.

Prof E Back, Feedback Consulting E&E Back KB, Sweden

My first question was already answered in the discussion. The primary fines to a certain extent are made up of parenchyma and ray cells and have a little similarity to secondary fines which are fibrils and fibril containing fines in parenchyma cells might actually have a negative effect because of their olephilic material. My second question. In general papermaking you want to compare the addition of fines at equal drainage and your data if replotted might give some information on this. If you make a comparison at equal density, when density is varied, eg by wet pressing do fines still have a positive effect when added. Do you have any data in this respect?

E Retulainen

The first thing I think there are differences in drainage between these two types of fines. Our paper was made in the sheet mould and if not more than 15% fines were added in most cases the drainage time did not increase much, in fact the increases were rather small. Only when we added 30% fines to the earlywood fractions did the drainage time go to 20 minutes or so. We have looked at strength against the density of handsheets and there is this normal trend that with increasing density, the tensile strength increases. There also seems to be some variation which might be due to this bond strength effect but this we have not thoroughly studied.