AHLSTROM MDRH2000 34" DISPERGER

The mechanical agitating device used in the practice of step (c) is, for example, a dispersing device, such as an MDR® disperser as sold by Ahlstrom Machinery, or a deflaking device, such as a deflaker-type pump, or any similar device which agitates the slurry to disrupt fiber flocs and reduce contaminant size and improve contaminant distribution.

Also, to provide a treated fibrous material for subsequent processing, it may be beneficial for the fiber separator **12** to include other equipment such as a fiber classifier, a dispersion system, and a kneading system. Examples of dispersion systems include: Krima (available from Cellwood, Corner and FMW), Diskperser (available from GL&V), Micar Processor, Diva (based on Conflo+HiPreheater fluffer/steam mixer. available from Metso Paper/Fiber); Frotapulper (available from MoDoMekan), Triturator/Kneading Disperser (available from Thermo Black Clawson, Lamort); Disperger (available from Voith Paper). Examples of kneading systems include: MDR Kneader (available from Andritz-Ahlstrom), Ultra Twin-Flyte (available from Thermo Black Clawson), Kneading-Disperger (available from Voith Paper).

885 kneading zone is long compared to disk dispersion and can be effective in imparting curl or entanglement. One example of a kneader is the Voith Sulzer KD-500 kneading disperger (so termed in the above-referenced article of Hostetter - kneading can be considered as one form of disperging for the purposes of the present invention). The Ahlstrom MDR® Kneader can also be used. Another example of a kneader is provided in

2.2. LOW SPEED KNEADING

Low speed kneading imparts a rather prolonged mechanical treatment (some minutes) to a large mass of fibrous material with a moderate shearing effect. This action is related to the relatively wide interbar clearance and slow rotation. Rotational speeds are normally 100–200 rpm, with a few exceptions at higher speed. The dispersion effect results mainly from fibre-to-fibre friction (rubbing action). In general, low-speed kneaders are devices in which the pulp is fed in by a screw and held by a discharge door as it is transferred under pressure between rows of fingers on a shaft and others on the stator wall.

Kneading technology for low speed dispersion consists of equipment with a single–shaft (Erwepa, Voith-Sulzer, Lamort-Fiberprep, Maule), or two shafts (Shinhama, Modomekan-Ahlstrom-Kamyr), specially developed for hot dispersion or resulting from technology transfer from stock mixers (Micar Black-Clawson). A typical single shaft kneader is illustrated in Fig. 6. Various designs are used for double shaft kneaders

The Shinhama low-speed kneader, illustrated in Fig. 7, has two counter-rotating shafts, one turning at 95 rpm, and the other rotating slightly faster at 110 rpm [30]. The device previously called "Frotapulper" (Modemekan-Kamyr), and currently referred to as "MDR Kneader," (Alhlstrom-Kamyr) looks like a low-speed kneader, but the two screws counter-rotate synchronously at a speed of 900- 1800 rpm (in the range of the of high-speed dispersers). The device called "Micar" (Black-Clawson) runs at intermediate speed (400-500 rpm) [12].

The discharge door controls the volume of pulp in the device. Stock moves through the device at a rather low speed. Differences in stock velocity are created inside the machine. The stock near the rotor is moving at a higher velocity than the stock near the stator wall. In the double shaft kneader, the rotors turn in opposite directions causing a shearing effect when the stock changes its direction of movement). These differences in velocity induce the fiber-to-fiber friction and the dispersion effect.

A gentle kneader including dewatering equipment has been proposed [31] and is illustrated in Fig. 8. It consits of 3 cylinders. At the first half of each cylinder, a screw boots the stock forward and at the latter half, the stock proceeds through kneading blades. When the stock proceeds from one cylinder to another, the rotation of shaft alters vice versa. In the third cylinder chemicals can be introduced. The 3 cylinders allow increasing the kneading time. Each cylinder is equipped with a single motor permitting an independent control of each of them so that it is possible to adjust the unit to a variation of stock and/or target quality of the pulp to be produced. In this kind of device, no steam introduction is required as the temperature can reach spontaneous 50 to 90°C due to the friction involved in the kneading parts. The energy consumption is between 40 and 80 kWh/T. The main difference with the other low-speed kneader is the presence of dewatering zone in the first and second cylinder. Thi

operate at temperatures up to 150° C. These conditi ons were required in board mills for asphalt dispersion.

For both types, the energy consumption is in the range of 35–100 kWh/t, with typical industrial values in the range 60-80 kWh/t. Various techniques can be used to adjust the energy consumption depending on the device used. These approaches include adjusting the pressure on the discharge door, gap between rotor and stator, inlet consistency, etc.

In the deinking plant, dispersion can be combined with bleaching. Bleaching chemicals can be introduced at the heating screw or at the inlet of the dispersion unit, which can be used as mixer or bleaching reactor. Depending on the operating temperature and the device used, retention time may or not be required after the dispersion unit.

Generally the pulp discharged from a low-speed kneader does not require dilution and bleaching is conducted at the kneading consistency. The pulp can be discharged at operating consistency in some high-speed dispersers but generally a dilution is required for discharge. In this case storage for bleaching extension is not possible.

4. DISPERSION

Various types of contaminants can be dispersed by using high-speed dispersers or low-speed kneaders. These include bitumen, waxes, stickies, specks, residual ink, and hot melt contaminants such as bookbinding or container sealing glues. Dispersion of wet–strength paper is also reported [71].

It must be brought to the fore that dispersing treatment induces fragmentation of the particles so that they cannot be seen. However, even if the pulp seems to be cleaner, these contaminants are still present in the pulp but they are not visible. If they are not removed during the next step of the process, some problems could appear in some cases during papermaking and during the final use of the product

Atta

High-quality print on coated papers with inks hardened by drying can also cause specks, which result from binding between the pigment and the coating material. Recovered papers, which produce these kinds of specks, are also glossy magazines. Papers printed by unconventional processes such as UV- cured inks [49] or some grades of modern digital print also induce speck formation.

A large recycling study of papers focusing on speckled deinked pulp and UV-varnished papers particularly, has been performed in the Centre Technique du Papier [50].

First, the specks from various origins have been compared regarding their difficulty to be dispersed by kneading. Trials were performed

99.9

Kneading efficiency (%) Resistant coating

at the CTP deinking pilot plant with a low speed kneader, which is a hot dispersion unit (TL0 from Lamort, 20 kg/hr). Results from resistant coated papers and UV varnished printed papers are reported in Fig. 12 [50].

99

90

UV varnish

Low energy is sufficient for dispersion of specks from resistant coated papers. With treatment at current industrial energy consumption (60 kWh/t) the pulp looks clean to the naked eye. Higher energy consumption is necessary for dispersal of specks from UV varnished printed papers. Good dispersion can be obtained at high temperature and with high energy consumption in a slow speed kneader.

- Energy consumption (kWh/t)

40
60
80
100
120
140
160
180
Pulp from unprinted wastepaper contaminated with 4 % of a pulp produced by pulping UV varnished printed papers or 10 % of a pulp produced from water resistant coated papers (offset printing). Influence of energy consumption. Pilot plant trials (pulp consistency 32 %, temperature 90°C). Efficiency is calculated as spec k
area reduction (specks larger than 100 µm).

Fig. 12 *Hot dispersion of specks in a low speed kneader [50].*

The work has been focused on UV-varnished papers; kneading and dispersing have been investigated as part of this study. Trials have been performed in pilot plants of machinery suppliers in order to optimize the dispersion of visible specks. Pulp for trials was produced at CTP by blending a pulp from unprinted papers with 2% contaminated pulp. Contaminated pulp contained UV-varnished printed papers pulped for 20 min at 14% consistency and 50° C with deinking chemicals. Fig. 13 to Fig. 15 show results from treatment of clean pulp mixed with 2% UV-varnish contaminated pulp (Unprinted wastepaper including 2 % of UV varnished printed papers. Particles larger than 100 µm were considered. Efficiency is calculated as speck area reduction).

BOTH LOW-SPEED KNEADERS AND HIGH-SPEED DISPERSERS ARE EFFICIENT IN REDUCING THE SIZE OF LARGE SPECKS

as shown Fig. 13 [51].
Influence of energy
consumption,
pulp
99.9

DISPERSION EFFICIENCY (%)

consistency and temperature on results in trials performed with an industrial low-speed kneader are shown in Fig. 14. Increasing pulp consistency and temperature improves the dispersion efficiency of specks from UV varnishes. Fig. 15 shows the results of trials performed with a high-speed disperser for dispersion of specks from UV varnishes [52]. Dispersion is more efficient at high temperature and, according to the machinery supplier, the implementation of a post deinking stage is recommended for removal of speck particles, which have been broken in smaller, floatable particles.
Kneading
99
90
Dispersing

- Energy consumption (kWh/t)

40 60 80 100 120 140 160 180
CTP pilot plant trials on industrial devices. Specks from UV varnishes, only specks larger than 300µm are considered.

9. SUMMARY

Dispersion treatment is used primarily as a means to improve appearance characteristics by disguising the presence of contaminants. When quality levels achieved by cleaning and screening are not adequate for a particular product, additional techniques can be used, which can include dispersion on the entire pulp or on a part of it, after fractionation. The aim of a dispersing treatment is
to disperse contaminants to such an extent that their detrimental effects are reduced.
Dispersion at high temperature was used initially to disperse bitumen when recycling OCC, and later to disperse other contaminants such as wax and hot melt glues.
For white grades, hot-dispersion was proposed to disperse hot melt contaminants and to improve
the visual aspect by dispersing residual ink and specks.

In high-speed disperser, all contaminants are reduced in size. They were then claimed to protect paper machine from stickies. However, because dispersion does not remove contaminants, but disperses them into the pulp, it can create some detrimental effects such as deposits on the paper machine. As a consequence of the progress made in cleaning and screening efficiency, hot dispersion has been questioned in the paper and board recycling units.

In brown grade recycling, high-speed disperser is the most popular technique used. The intensity of its action is determined by the design of the disc, the energy input (generally between 40 and 80 kWh/T), temperature, residence time and the gap between the discs. Narrow disc gaps, low temperature and high residence time increase the dispersing intensity (that allow good dispersion to be achieved) but also increase the freeness loss.

For deinking application, the future of hot dispersion is mainly related to the improvement of the deinking efficiency. Both high-speed dispersers and low-speed kneaders are proposed for the improvement in ink detachment, mainly before post-flotation. Various high-speed dispersing and low- speed kneading technologies are proposed and the choice of the most effective type is the subject of debate. A combination of the various technologies in order to combine the advantages of each is also proposed.

Actually, a regain of interest appears on the development of paper mechanical properties of the pulp during these stages. Under typical high-speed dispersing conditions, burst and tensile properties are enhanced, similar to low consistency refining, but without the freeness loss caused by cutting in refiner. Under high temperature conditions, fibre cutting is further limited in high-speed disperser. High-speed dispersion and low-speed kneading can introduce curl into the treated fibres. Low-speed kneader induces more higher fibre curl, mainly because of higher residence time. This affects then tear strength, dimensional stability, bulk, etc.

New applications, such as microbiological decontamination, by using chemicals in a low-speed kneader, have also been proposed.