Solvent Dispersant Additives for Waste Paper (Secondary Fiber) Utilization

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The use of waste paper (Secondary fiber) is a topic of interest to nearly all paper mills these days. Due to limited availability of natural raw materials paper mills were prompt in utilisating and processing waste paper. As more and more secondary fibers from various sources have been included in paper machine furnishes, an increasing number of operating problems have also been encountered. As these problems are tremendously varied and they extend all the way from the hydrapulper to the rewinder. Hence we could not establish well and can better utilise the same stock for preparing Bond paper and high quality tissue paper.

Application of what might be called the repulping and de-inking aids or solvent dispersant class of chemical additives can make a major contribution to overcome many of the difficulties encountered in the use of waste paper. Performance proved additives of international recognition are now avilable in India.

DEFIBERING & REMOVAL OF INK :

In the use of secondary fibers there can be problems with the defibering of certain papers to obtain an adequately dispersed furnish. In many cases there is only a need for ordinary commodity type chemicals for the repulping operation. Some of these chemicals which assist in the defibering and removal of ink particles from waste paper include caustic soda, soda ash, sodium hypochlorite etc. These chemicals when used with sufficient heat and proper equipment, can usually adequately perform the defibering & removal of ink particles of most grades of waste paper. However. particularly in the case of waste paper containing significant amounts of wet-strength additives, there can be problems in getting the papers quickly and sufficiently repulped. Speciality chemicals and solvent dispersant additives or deinking aid can be used in these special cases for assistance in the above operation.

While using waste paper, numerous deposit problems are encountered because of many contaminants brought in. This results in decreased production and possibly poor quality control. The deposit problems are often related to inadequpte removal or dispersion of the contamicoming into the finished paper making operation from waste paper. Proper use of certain solvent dispersant additives becomes necessary to alleviate some of these problems. In practice, a combination of caustic and solvent dispersant additive is found to be more effective for the above process.

REPULPING TECHNIQUES AND CONSIDERATIONS :

The usual technique which is practised in using a deinking aid or solvent dispersant type of repulping aid is to add full quantity of additive aid at the beginning or in the early stages of the repulping cycle. However, in practice, it is observed and followed a supplemental addition of the solvent dispersant combination at the stage where handsheets show only fiber bundles remaining, can singnificantly speed up the repulping process. It is the breaking up of these remaining fider bundles that frequently prolongs the repulping period and the use of the additive to accelerate this stage of the repulping can provide a major reduction in total repulping time. The technique of supplemental additional of solvent dispersant additive at the fiber bundle stage has been shown to be particularly effective with paper or board having a high degree of wet strength.

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PREPARATION OF THE SECONDARY FIBER STOCK:

Preparation of the secondary fibers stock is takes place at Hydrapulper. As the waste paper is charged, the pulping process must be controlled by the addition of chemicals and partly by maintaining suitable temperature, pH and pulp consistency to achieve as complete as possible a separation of the printing ink from the fibers. Now looking into these parameters :—

a) Agitation : With charging of waste paper, agitation should be started. Increased agitation increases the efficiency of repulping. It greatly prompts chemical action by breaking up the fiber masses and exposing ever-greater surfaces to the chemical action. It also helps to achieve colloidal or semicolloidal dispersion of the contaminants and other non cellulosic ingredients in the secondary fiber.

b) Temperature & Pressure : Pressure is usually atmospheric, thus limiting the maximum temperature to 100°C. The ideal temperature for repulping secondary fiber varies with each mill according to their needs, equipment and raw materials. Higher temperatures most certainly aid in the repulping of wet strength grades. It also increases the effectiveness of the secondary solvent additive used alone or with other chemicals in the repulping operation. Usually high temperatures are desirable for speed & effectiveness of re-pulping. One possible exception would be high groundwood pulps where better defibering & deinking may occur at lower temperatures.

We recommend temperature of 60°C and time period of upto 1 hour.

c) Consistency : The consistency employed in the repulping process has a great effect on the efficiency of the operation. The type of equipment, particularly the type of agitation, certainly places limits on the permissible consistency. Within allowed limitations, of HP of motor increasing the consistency leads to improved efficiency. Higher consistency allows conservation in both repulping chemicals and heat.

Figure A (1) : Demonstrates how the effectiveness of a solvent dispersant additive is increased as the repulping consistency is raised, even though the same

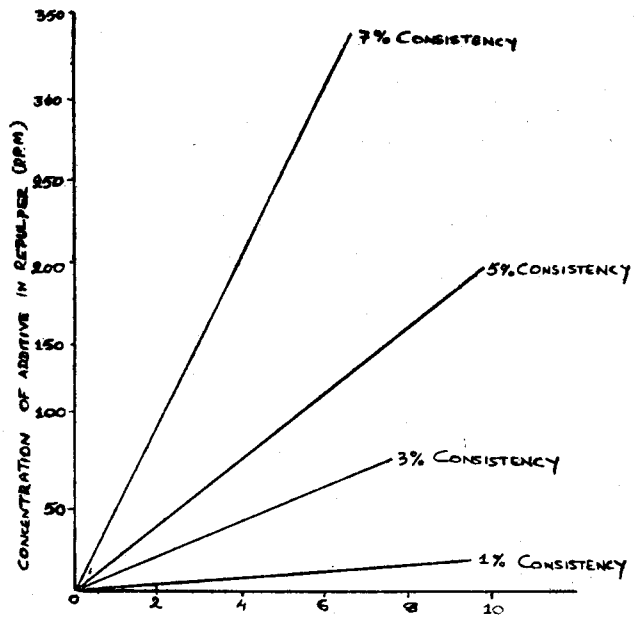


FIG. 1—TREATMENT RATE OF ADDITIVE (PAPERTON)

treatment rate in kg per ton (or the same cost) is used in each case. Further more, it has often been demonstrated that defibering is much more efficient at higher consistencies due to the greatly increased shear forces involved as lumps of stock impinge egainst each other. In India, majority of hydrapulpers operate at 3% consistency. However, if motor HP permits, we recommend upto 10%.

d) Water : Deinking with solvent can effectively work if water used for repulping stock is of good quality. Basically Deinking is a laundering process. Once ink has been removed from the fiber by use of additives; water plays a significant role in carrying the said particles along with them during washing of the pulp or by froth flotation method

In practice to make solvent dispersant additive more effective fresh water should be used. Soft water is highly recommended, but in scarcity areas raw water having hardness less than 180 ppm as $CaCo_3$ may be used for repulping secondary fiber stock. The use of white water, shall not be able to Justify the benefits of solvent dispersant additive.

e) pH : The most effective pH at which to repulp, certainly varies with the nature of the secondary

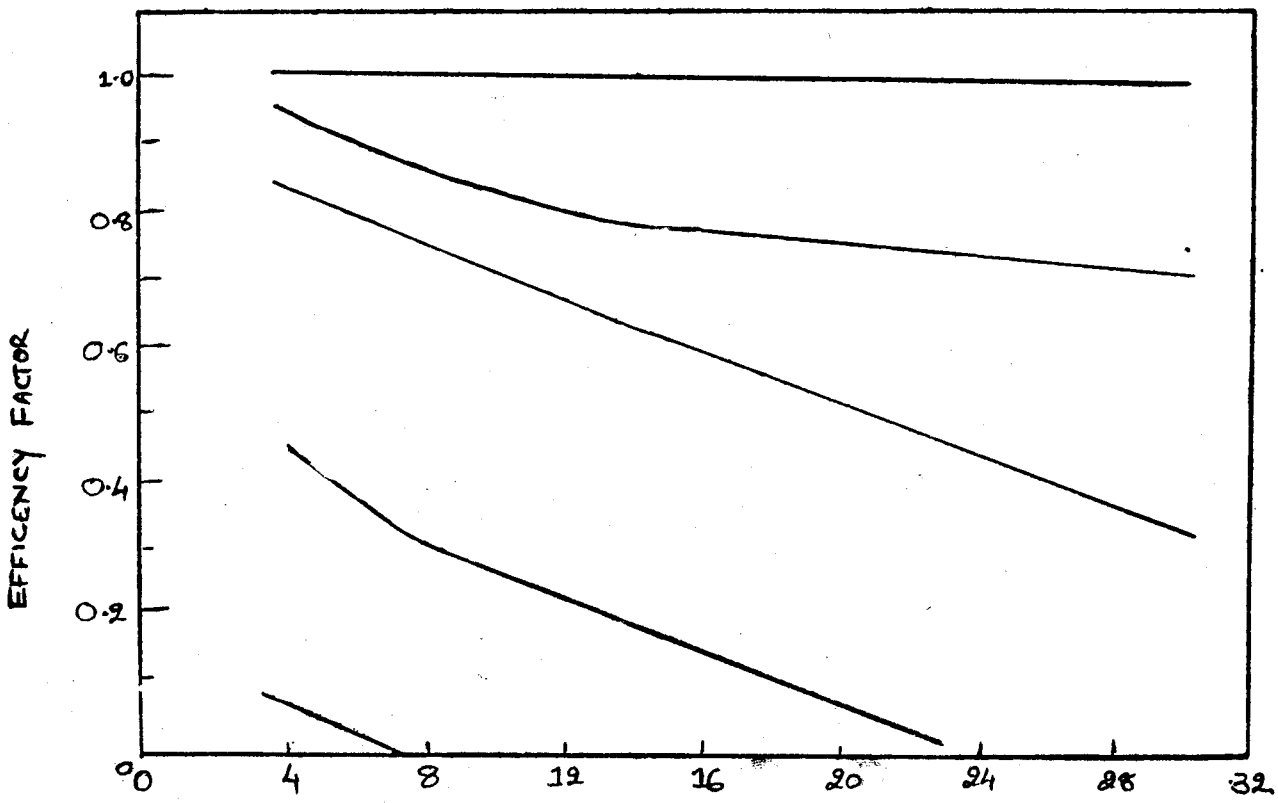
fiber. In case of wet strength paper, and elevated pH of 10 to 11 is desired. At this pH, formation of foam cannot be ruled out. Normally, pH of 10 is recommended while employing solvent dispersant additives.

f) Foam : If foam is formed in hydrapulper, it will be at the centre of the hydrapulper. This foam is of importance, because the ink particles detached from the fiber will adhere to the foam and thus can be removed manually. In the absence of foam, addition of foaming agent may bring down the load, in removal of ink particles at washing stages of pulp.

g) Particle size : Size of ink particles has significance. Investigations have shown that while ink particles of 2–12 mm are effectively removed almost entirely, efficiency generally drops with growing particle size. Solvent dispersant additive, during repulping stage of secondary fibers breaks down the particle sizes. Although ink pigment is non-soluble, the more it can be dispersed the greater will be the efficiency of the removal of particles. The efficiency of any particular size ink particles is closely related with washer discharge consistency. This is illustrated in Fig 'B' (2) for e.g. Actual removal of finely dispersed particles (15 μm or less) is 100% of the theoretical values upto 28–32 % discharge consistency. Removal of 50 μm particles at the same discharge consistency is only 30% of the theoretical values. Virtually no removal of 100 μm particles results above 20% discharge consistency.

WASHING OR FLOTATION :

Successful removal of the ink particles, and the benefits of using solvent dispersant additive at repulping stage is derived by washing of the pulp or by froth flotation process. Any one of the above method can be used; but its necessity is of prime importance. As mentioned earlier, deinking is fundamentally a laundering process. Maximum utilization of water should be there in washing process. To save water and increase fiber yield, counter current washing process is often used. The pulp is diluted with clarified water only ahead of the last washing stage. If possible, two to



FIGURE–B. PARTICLE REMOVAL FFFICIENCY

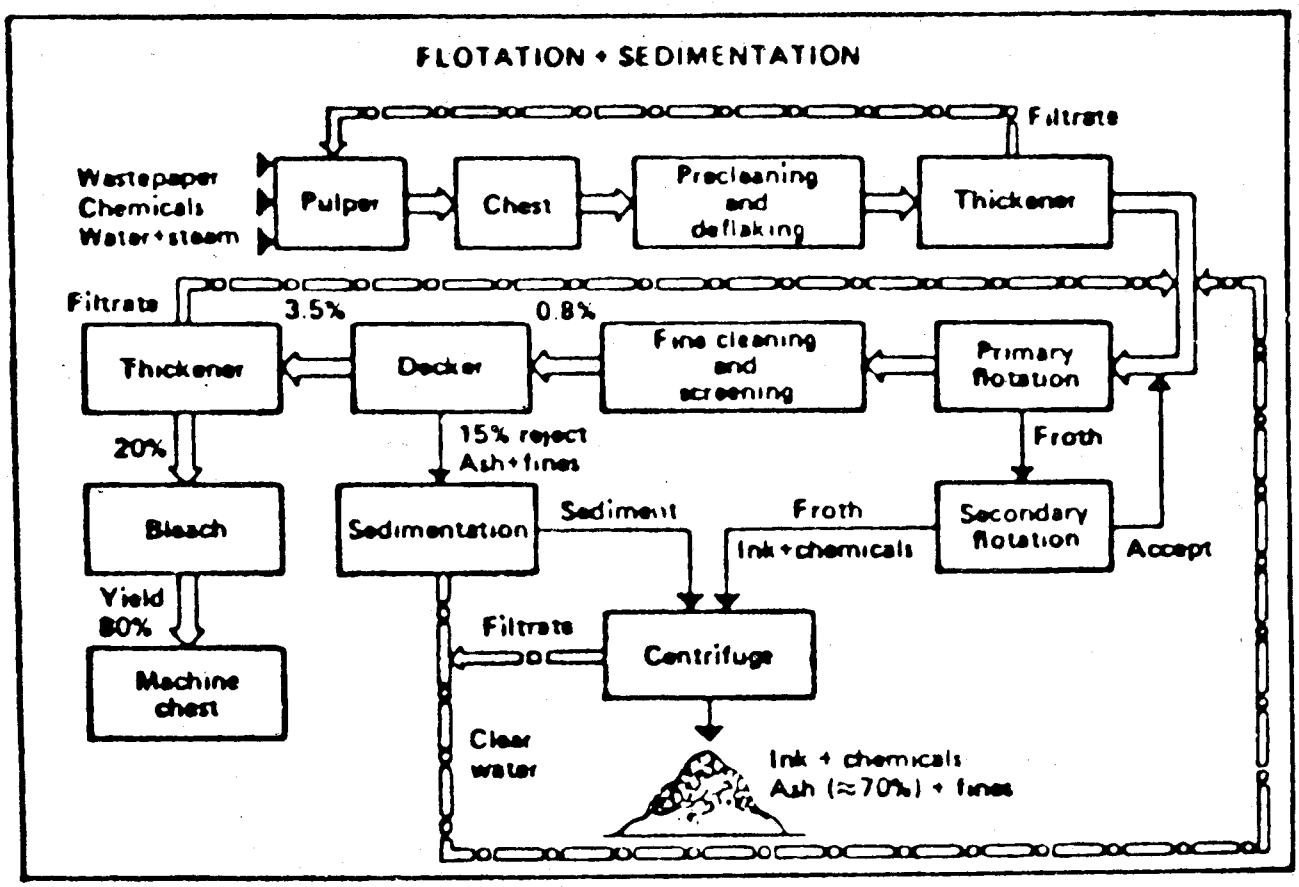
three stage washing should be given to pulp; the counter current flow does not significantly decrease over all system washing efficiency but, its operation would result in 1/3rd of inky effluent per ton of fiber compared to concurrent flow.

In flotation system, the ink is deposited by collecting agents (fatty acids or soaps) on to air bubbles. The purpose of flotation cell is to blend the required air, in the form of small bubbles with the stock suspension. The air bubbles, covered with ink particles and dirt, rise to the surface of the cell and are skimmed off as a layer of froth.

Research is in progress with use of solvent dispersant additive combination of washing & flotation processes and taking advantage of the positive aspects of each system. such a system is shown in figure 'C'[4]. In principle, the process is basically a flotation process. However a thickening step is added, and the filtrates very rich in ash is fed to a sedimentation chamber. The benefits derived from solvent dispersant additive may be enhanced if washing or flotation or both processes are employed. If the pulp goes to machine chest without such processes, the final paper will be of poor quality, having large number of ink and other particles and having low brightness.

DEPOSIT CONTROL :

Mau paper makers are obliged to utilize lower quality secondary fibers, which often include many extremely troublesome contaminants, hot melt adhesives asphalts, latexes, waxes, inks, coating binders, pigment etc. The repulping of waste paper containing these and other substances is often difficult but of utmost importance in that inadequata dispersion or removal of these contaminants will certainly lead to a number of problems on paper machine. These problems manifest themselves in the form of deposits that plug cylinder molds, fourdrinier, wires, fabrics and felts. The deposits may also accumulate on press rolls, dryers, and rewinders



Flotation process with washing stage added

FIGURE—C

and even carry through into coverting operation. The end result can be lower production rates, poorer quality & most certainly, continual operating difficulties.

In order to attack the deposit problem at the source, the first step is to initiate treatment at the repulper with solvent dispersant additive that will aid in the repulping operation. To be precise, many of the contaminants are insoluble in water and very hydrophobic. While it is desirable to physically remove as many of these contaminants as possible, limited technology and a complex array of contaminants makes this almost an impossible task hence to minimize the deposit problems, use of solvent-dispersant additive's general programme on deposit control for machines using waste paper may be followed.

Adequate deposit control generally requires a concentration of 1 to 10 ppm of additive based on the total amount of pulp and water at maximum dilution. The exact recommendation will of-course depend on the severity of the deposit problem. Fig. 'D' (5) helps to clarify this by showing what the concentration of the solvent dispersant additive would be at maximum dilution in relation to the variables of treatment rate in kg/ton of waste paper, percent secondary fiber in the paper machine flurnish and various headbox consistencies. Although with above control program, it may also be necessary to make supplemental treatments with the solvent dispersant additive when the contamination load is high e. g. with certain especially troublesome contaminants.

These additional applications are usually dictated by where deposits are forming and may include continuous additions of the additive to wire showers, showers on press rolls & felt showers. There may also be a need for supplemental treatment to the stock before refining or at the machine chests.

It is a fact that a properly planned and co-ordinated deposit control program with an effective solvent dispersant additive can greatly reduce or eliminate the need for batch washing and the down time that it necessitates.

FIGURE D

The relationship between the use rate of an additive for repulping and its effective concentration at maximum dilution

Use rate of repulping aid Kg/ton of secondary fiber	Secondary fiber in furnish %	Concentration of repulping aid at headbox (P. P. M) Headbox consistency			
		0.3%	0.5%	0.7%	1.0%
1.5	10	0.45	0.75	1.05	1.5
1.5	30	1.35	2.25	3.15	4.5
1.5	100	4.5	7.5	10.5	15.0
2.5	10	0.75	1.25	1.75	2.5
2.5	30	2.25	3.75	5.25	7.5
2.5	100	7.5	12.5	17.5	25.0
5.0	10	1.5	2·5	3.5	5.0
5.0	30	4.5	7.5	10.5	15.0
5.0	100	15.0	25.0	35.0	50.0

Mill trials :—

Mill No. 1 :—

Furnish	:	70% C. P. O. 30% Rekord
Temp.	:	60° C time : 50–60 min.
Dosage	:	1.5 kg. per ton
Consist	:	6%
Washing	:	Poacher washer (2 stage washing)
Benefiit	:	Pulp brighter, elimination of ink particles on paper, use of low quality waste paper,
	:	Good market value of finished paper system remains good fewer breakages

Mill No. 2 :—

Furnish	:	50% B & W 50% Rekord
Temp.	:	55° C
Dosage	:	1.5 kg per ton + 1.5% Caustic Soda
Time	:	60 min.
Consist	:	5%
Washing	:	Poacher Washer (1 stage) + Decker thickner
Benefits	:	Pulp brighter, dispersed ink, particles eliminated with washing use of 50% rekord paper, less deposit control.

Mill No. 3 :—

Furnish	:	100% Imported lazer printing
Temp.	:	65° C
Dosage	:	2 kg per ton + 1% caustic soda
Time	:	50 min.
Washing	:	Poacher washer (2 stage washing)
Benefits	:	The ink particles completely detachable from fibres, pulp brighter. Good market value of paper No deposits.

SUMMARY/CONCLUSION/NEED OF A SOLVENT DISPERATION ADDITIVE

In short, the increased use of waste paper in machine furnishes has greatly increased the number and severity of pulping and machine operating problems. To aid in overcoming these problems what may be termed solvent dispersant additives have been developed. These chemicals often labled as "repulping aids" not only facilitate control programs for machines using waste paper. The judicious use of these additives can yield the following benefits.

(1) Reduced plugging of wires, forming fabrics and press felts.

(2) Reduced deposit formation on cyclinder molds, dandy rolls, press rolls, dryers & rewinders.

(3) Helps repulping better.

(4) Reduced machine downtime.

(5) Potential use of lower quality fiber sources.

(6) Fewer problems related to recycled fibers in converting operation.

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