

Factors Influencing the life of Fourdrinier Wires

K. K. Misrfa and

D. N. Chakravarty

Fourdrinier wire can aptly be described as the soul of the paper machine—since the birth of a paper sheet takes place on it and it is hardly necessary to comment on the importance to the paper industry of the problems presented by the necessity of frequent replacement of the Fourdrinier Wire. In fact, the factors determining the behaviour and life of Fourdrinier Wires are so many and so complex that it is obviously impossible to discuss all of them or to estimate their relative importance.

However, close co-operation between the paper manufacturers and the wire manufacturers over a number of years has greatly contributed to the advancement in the technique of wire manufacture. The wire life and wire costs have been the subject of numerous discussions in recent years and as such the wire makers have been continuously trying to meet the demand of the paper industry on their products for creating changes and improvements, wherever needed. As a result, originally a highly skilled art, the manufacture of Fourdrinier Wire has been now considerably revolutionised by scientific control. From hand driven affairs, the wire weaving looms have been developed into modern, electrically operated, automatic ones, and, the older joining methods, whereby woven wire cloth is joined for making it endless, have been developed from sewed seams to soldered seams and more recently to electric and gas welded seams. Since the success or failure of a wire depends to quite a big extent upon its reaction, as a metal product, to the destructive forces on it, extreme precautions are taken at the wire manufacturers end during each process of manufacture so that the Fourdrinier Wire leaves their Factory with best physical properties for ensuring its maximum efficiency.

In this context, it will be interesting to examine the basic factors, individually and combined, governing the life of a Fourdrinier Wire.

ABRASION

The greatest single destructive influence con-

tributing to the wear of wire on the paper machine is the abrasive effect caused by the particles of silica and china clay which become embedded on the tops of the Suction Boxes. The effect of temperature during different months of the year on the metals employed in manufacture of Fourdrinier wire also plays an important role in accentuating abrasive forces. It has been found in various cases that during the winter season the life of a wire is considerably more than in the summer season. Abrasion also takes place on the corroded exposed surface of the wire cloth subject to unnatural spot wear, especially when at the boxes and couch roll considerable quantity of copper is removed from the alloys. Uneven tension resulting into wire slippage on couch roll and wrinkles or telescoping created by mishandling also results into unnatural abrasion on the wire cloth.

During the recent years, however, intensive research has been carried on for improvement of Suction Box covers; and the old wooden covers are being now replaced by modern plastic, synthetic, stainless steel and silicon carbide covers. A remarkable increase in wire life has been observed in some of the American and Canadian newsprint machines by introduction of silicon carbide Suction Box Covers, with a very low co-efficient of friction. In fact, the synthetic and stainless steel covers have been in many instances responsible for 30/50% increase in the wire life.

Although, abrasive forces cannot be totally avoided since the metallic wire cloth is in constant contact with the rollers as well as other moveable and immovable parts of the paper machine, efforts have been made by the wire manufacturers as well as by the paper machine manufacturers to minimise the abrasive action on the wire cloth. Oscillating Suction Boxes and rubber covered table rollers are practically becoming a standard on new paper machines, thereby reducing abrasive action on the wire cloth. On the other hand, wire manufacturers have also devised "Snake Weave" in which the wire has a tendency to oscillate between

4 to 10 mm. amplitude so that friction "on the spot" is greatly minimised.

CORROSION

The three main factors, which effect the corrosion of wires in paper making, are Acidity, Temperature and Air Saturation (degree of aeration).

The paper mills normally operating with a constant acidity or pH throughout the year, have faced corrosion on wires when the temperature of water rises, and it increases even further with low water and increased air saturation.

The different forms of corrosion on wire cloth are :—

- (a) Direct chemical action.
- (b) Pitting or galvanic action, specially on soldered seams.
- (c) Dezincification and corrosion cracking.

Any one of these forms of corrosion is effected by one or more by the above factors, since each metal reacts differently for a given set of conditions. Direct chemical reaction occurs when acid and reactants combine with the metal to form non-metallic salts. Air, which is the most prevalent form of oxidising agent, will greatly accelerate its action.

Corrosion cracking normally happens when the surface of any metal has been attacked by any of the above factors, which combined with metal fatigue, accelerates the development of cracks which will in turn give further penetration of the corrosive forces.

It may be noted here that corrosion and abrasion are also interdependent. For example, if abrasive force is present in the wire vicinity, it will serve to remove the normal oxidised film from the wire and expose the metal to corrosion. Similarly, if corrosive conditions are present, after the metal is partially eaten away the exposed surface will be very much susceptible to even the slightest abrasive action.

During the recent years, in addition to the introduction of synthetic Suction Box Covers, various chemical, (also called 'wire life extenders')

are being used in the paper mills to safeguard the Fourdrinier wire against abrasive and corrosive forces. However, to select the right type of chemical for a particular problem, a proper study of wire failures is very much required. Theoretically speaking, the ideal chemical for extending the wire life, should have the following properties which tend to safeguard the Fourdrinier wire both against abrasion and corrosion.

1. The chemical should act as a clearing agent (in order to safeguard clogging and the resultant abrasion).
2. It must form a sort of film on the exposed surface of the wire cloth (to safeguard against corrosion).
3. It should also act as a lubricating agent (to safeguard against metal fatigue).

So far it has been found that among the various chemicals Mercaptobenzothiazole (also called MBT), when mixed with organic sulphur has proved to be a very good safeguarding agent against corrosion. Such chemicals are normally used, mixed with water through the showers on the return cycle of the Fourdrinier wire on a paper machine and it has been found that wire life increases by about 20 to 30%.

The Human Factors—Damage to the Wire cloth

Since the Fourdrinier Wire is a very delicate product, mishandling during the transit or at the paper mills, results into various types of deformations on its surface, which, ultimately results into a premature failure of the same, although it may have been manufactured with utmost care. The most common types of deformations are occurrence of creases or telescoping in the wire cloth causing wavyness which ultimately results into wear at certain spots and thereby failure of the wire cloth. This happens normally when the wire boxes are dropped on ends during transits or when the wire is not packed properly.

In fact, it has been rightly pointed out by some of the eminent authorities on the subject that the proper maintenance of the Fourdrinier machine is a key to machine efficiency and wire life. Perfect cleanliness of the machine, adequate and powerful shower system, proper care at the time of putting on the wire and a proper check up of

the various rollers are imperative in order to get the maximum life from a wire and prevent frequent shut-downs. In the present age of competition when modern paper machines are making paper even at the speed of 3,000 ft. per minute, wire life has been one of the most talked about subject for discussion and research. No modern paper mill can afford frequent shut-downs on account of changing or repairing the wire, as it reduces efficiency and increases cost of production.

Accordingly, numerous experiments are still being carried on for extending the wire life by replacing the conventional metal wire cloth with different alloys or synthetic fibres as raw materials. From the very beginning of wire making, Fourdrinier Wires have been manufactured always with phosphor Bronze (C 93% S N & P 7%) as warp, and tombac (C80%, ZN 20%) as weft wires. Till today these raw materials have been proved to be ideal for making Fourdrinier Wire to withstand the terrific strain while running on the paper machine.

Most significant development in this context is the manufacture of plastic wire fabric woven from polyamide and polyester synthetic fibres. Theoretically speaking, the plastic wire has many advantages over the conventional metal wires, i.e., it gives better sheet formation, lesser wire mark and on account of its being lightweight the transit damages are also safeguarded. The most important advantage, of course, is its longer life since it is practically immune to the corrosive and abrasive forces. Formax Co. (U. S. A.) has made remarkable progress in manufacture of plastic wires which have been successfully run on various types of paper machines in the U. S. A..

Canada and Europe. By field experiments, it has been found that wire life has increased upto 60 to 80%, although certain parts of the paper machines have to be modified and altered for being able to use the plastic wires.

Another experiment is being made with chromium plated wires where the ordinary phosphor Bronze Wire Cloth is coated with a special type of chromium compound during the finishing stage of its manufacture. This type of Fourdrinier Wire is superior to the conventional wire, especially where a paper mill is faced with acute problem of corrosion and abrasion. During 1962-63 this type of wires have been tried at a number of American Paper Mills; and the wire life had been found almost to be double than those of conventional wire.

Similarly, the suitability of stainless steel as raw material for fourdrinier wire is also under investigation from a long time and several field experiments have proved that on certain types of paper machines for making selected grades of paper, stainless steel Fourdrinier Wire have resulted into a big increase in the wire life.

While the world still awaits further new developments in the manufacture of Fourdrinier Wires with different types of raw materials for increasing its life, it remains a fact that Fourdrinier Wire is essentially a tailor-made product, specifically made to suit each individual paper machine's requirements. It is, therefore, vitally essential that there is always a spirit of mutual co-operation between the paper maker and the wire maker which will mainly help towards manufacture of right type of wire for each individual machine and will ensure its maximum efficiency.