Manufacture and use of Paper Machine Wires.

Paper Machines have their peculiarities and more often than not the machine wires have to be tailor made to suit. The factors like the tensile strength of the wrap wire, ductility, resistance to corrosion and fatigue have to be borne in mind in the wire manufacture.

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The author has given a detailed account of the various phases in the wire manufacture like weaving and stitching. Factors that influence the behaviour and life of the fourdrinier wires are also discussed.

Introduction :

Modern paper industry has ever increasing demand on the Fourdrinier Wire and the Wire cloth performance. A uniform quality in respect of drainage as well a surface is the uncompromising demand from every maker of high quality paper. Paper machines have their peculiarities and more often than not the machine wires, therefore, have to be "tailor made" to suit. This is in turn necessitates first class plant ; metallurgical research, long experience etc.. Steadily increasing demands also require continuous research.

We have the advantage of controlling the manufacture of the Wires from Wire Drawing process up to the finished product. Our equipped Laboratory makes continuous and thorough control of each step of the manufacturing. From our experience now we can manufacture the right wire for each application.

In manufacturing Fourdrinier wires there are many factors of importance which must be fully recognised and dealt with if the wire is to give a satisfactory run : e.g.

(1) The tensile strength of warp wire.

(2) The ductility of the wire.

(3) The abrasion resistance

(4) Resistance to corrosion and

(5) Resistance to fatigue.

The problem then is to find the metal or metals which have the above characteristics and to develop these in the proper balance during the Wire Drawing Operation. This involves correct scheduling of drawing and annealing so as to build up the resistance to the destructive forces mentioned. Present Wire Drawing, improved machinery, lubricants dies, and wire annealing method in controlled temperatures and controlled atmospheres, all of which produced wire as at can be held more closely to the exact size.

Phosphor Bronze Wire as warp and Tombac wire as weft wire is the right material at the movement for making Fourdrinier cloth, as bronze alloys are less susceptible to corrosion and corrosion cracking and also it had the power to withstand the chemical resistance and mechanical strength. But composition of material does not give a definite picture of the characteristics qualities of the finished wire. Such qualities are dependent on the crystallin structure and therefore, they may be considerably changed by drawing and annealing.

In this connection, it is interesting to note the great amount of research being done on the so called Stainless Steels. So far these chromium-iron alloys have had their shortcomings in so far as the foundrinier wire is concerned although they are rapidly finding their way into the cylinder faces and into chemical industries.

Manufacturing Process :

In the weaving operation many of the characteristics of the finished wire cloth are formed. The rigidity of the cloth, its resistance to curling and the actual count of the mesh, all originate in the weaving operation. By varying the size of the shoot and warp wires, and their strength, number of types or

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cloth may be produced for the production of various papers. The type of weaving is important for fitting and shifting. The strength and flexibility of the wire also depend on this. In most cases these requirements cannot all be satisfied to the same degree and then the most suitable combbination of qualities must be determined. It was found under practical condition that wires of the same number and type of weaving do not always show the same reaction. This needs constant observation, study, for making suitable wire.

Weaving of wire cloth is an intricate process involving suitable crimp formation, allowance for tension and flexibility and the correct mesh formation. We have developed new techniques in wire weaving to suit individual paper machines requirement. We have recently installed a device in our loom for making Snake weave or Oscilating weave of wire cloth with amplitude of 2-8 mm. This type of weave is ideal for paper machines with stationery suction boxes with rough or wooden tops. Due to oscilation there is virtually no abrasion on the warp and weft strands and therefore better life can be expected from such wires. Another of the noteworthy manufacturing research done in our Factory is the use of "Reverse Twill" arrangement in a few of our looms which gives a better finish on the surface for sheet formation properties. To eliminate acute edge cracking problem on wires on certain machines, we have introduced "Trevira Edges" where Trevira wires are woven on the loom in a certain pattern as warp wires.

After the wire cloth is woven it is seamed to make it endless in an atmospherically controlled chamber by expert welders. The various of this important process have been dealt with by my colleague yesterday.

When a wire cloth is made endless it is put on a Stretching Machine for giving tension, having final inspection and edge trimming which have been shown to you during your visit to our weaving Section. Stretching operation is also a skill and specialised one which needs proper care and attention. After the wire cloth is stretched, it is packed in wooden or steel poles which are properly secured by iron plates, nuts and bolts and wedges. The wire box in which the poles along with the wire is put is made of strong wooden planks, reinforced by steel plates on the corners. Wood wool polythene, kraft and waterproof paper are also used to cover the wire cloth before it is put on the box to prevent any damage during transit. Of course, these operations have been seen by you all in detail yesterday in our Factory and I shall therefore deal in the question of wire life vis-a-vis Paper Machine and the problems encountered on various paper machines.

Wire Use And Wire Lie :

It is hardly necessary to comment on the importance to the Paper Industry of the problem presented by the necessity of frequent replacement of fourdrinier wires. The factors that determine the behaviour and life of fourdrinier wires are so many and so complex that it is obviously impossible to discuss them all or to estimate their relative importance. However, some of these factors such as,

(a) Mechanical condition of parts.

(b) Roll coverings.

(c) Surface of wire boxes, forming boards, deflectors.

(d) Alignments of machines compound.

(e) Corrosion prevention.

(f) Cleanliness.

seems capable of analysis. Since it is possible that an analysis may point the way to improvements in fourdrinier wire life, it will be attempted for what it may be worth.

Breast Roll :

The alignment of the breast roll is of first importance to a time running wire. Because of its heavy wire warp, the breast roll, along with the Couch Roll or Wire turning roll is more potent in guiding the wire than the other components on which the wire rides.

If the breast roll is not raised properly a strain can be placed on the raising arm, and the resulting distortion of this arm can change the alignment of the forming board.

Since there is variation in raising arm in each wire change, flow looks entirely different. The breast roll should be raised

in the same manner after each wire change.

Forming Board :

The primary purpose of the forming board is to support the wire between the breast roll and the first table roll. The wire sags following the breast roll because of the pumping action of the breast roll. On some grades of paper or board this pumping action is necessary to assist the water removal in the forming section. If this is the case, the forming board should be fitted in such a way that the wire does not break sharply over the forming board tip. The forming board tip should be set as close to the breast roll as is possible without jamming up the water removed at this point.

Table Rolls:

Table roll surfaces should be kept clean. This is particularly true of grooved rolls where stock accummulation can throw the rolls out of balance, or defect the purpose of the grooved table roll which is to break the suction at the off-going wire nip.

Table roll surfaces, therefore, should be hosed off thoroughly before a new wire is mounted. Rubber covers may blister from corrosion at the surface of the Motal Core. Rolls should be recovered when necessary.

Misalignment of table rolls is indicated when the wire runs to the front or back side when the stock is put on the wire and run to the opposite side when the stock is removed. In squaring the table rolls, the important thing is to set each roll in relation to the centre line of breast roll rather than the adjacent roll.

Deflectors :

On high speed paper machines, the wire requires support affer table rolls where the pumping action is heavy. The flat top deflector supports the wire and performs the same function as the forming board (edges should be well dressed).

Wire Suction Box :

The friction between the wire and the surfaces of the flat boxes constitutes the major load on the fourdrinier drive. It is the major source of wire wear. It is necessary to keep the flat box covers as smooth as possible first by keeping the covers moist during shut down to prevent warpage or shrinkage and second to keep the wire from grooving the covers by either oscillating the boxes or the snake weave in wire. Wire friction can also be reduced by the choice of appropriate materials for flat box covers and there is considerable improvements in wire life.

Embedded grit in wire box covers has been a cause of short wire life. Flat box covers should be examined for embedded grit or sand, performance of stock clearners should be checked, if required.

Couch Roll :

The friction beween the couch roll shell and its suction box packing strips can consume a considerable amount of horse-power. This friction can also cause difficulty in starting up the fourdrinier. It is necessary to keep the friction load at a minimum. Couch roll shell holes should be claened and drilled as and when required. The couch roll and wire turning roll can get out of alignment because of play between the keys and key-ways in the remover blocks. These should be examined on every wire change.

Turning and Return Rolls :

The surfaces of the wire turning roll and wire return rolls must be in good condition to prevent damage to the wire. Metallic surfaces should be free of nicks and grooves. Rubber covers should be replaced if blistered. The alignments and levelness of these rolls is important because of the grinding potentialities of these rolls.

The structural rigidity of these rolls should be sufficient to withstand all probable wire tension forces. Otherwise, this wire tension may cause excessive deflection on the rolls. This results into wrinkled wire.

Showers :

An efficient shower system is essential to wire life because there is always present the danger of stock getting between the wire and the wire return rolls and causing ridges. Wire cleaning shower should be of the high pressure jet type and should be oscillated, and spray pattern should be uniform.

If the shower water is not filtered, it may cause dimple in the wire.

Doctors :

The purpose of the doctors, like the showers, is to protect the life of the wire. An efficient breast roll doctor is very vital to wire longevity. Any stock falling into the wire will be carried into the nip between the wire and the breast roll and very likely cause a ridge on wire. Doctors should be fitted in right position.

Wire Tension controller :

One of greatest aids to wire life and consistency in the quality of the sheet is the wire tension controller. One of the important things to remember about this device is that the air spring is kept within its working range by the lift arm. When the length of the fourdrinier wire changes, the stretch roll establishes a new position which is determined by the balance between wire tension force and the air spring force. If this new position is out side of the working range of the spring, the first thing to do is to raise or lower the lift arm to set the spring at the operating position, then adjust the air pressure in the air spring for the new angle of the stretch roll.

Roll Bearing Lubrication:

Proper lubrication, cleaning, checkup is needed.

Wire Change Gear :

Wire changing equipment should be in good condition, so that, the wire can be put on safely and without damage to the wire. The surface of wire. holes should be smooth.

Stress Analysis :

Apart from these factors, mechanical stresses and the effect of wear on stress is also an important factor for wire life.

For purpose of stress analysis a fourdrinier wire can be considered as an endless belt driven by couch roll and driving the other rolls on the paper machine. The warp wires, since they are parallel to the direction of movements, have to carry all the load, the shoot wires serve principally to provide rigidity and for all practical purposes are not affected by the operating factors producing stress in the warp wires. In operation the warp wires are stress as follows : —

(1) A tensile stress due to the driving tension.
(2) An additional tensile stress due to the initial tension set up by the stretch roll.
(3) Bending stresses due to contact through an arc with the rolls over which the wire passes, and the edges of the suction boxes.
(4) Tensile stresses arising from accelerations in driving the screen. These are important only when the machine is started up and can hardly be determined by calculation. As the wire wears, these stresses are subject to change due to alteration in the sectional area of wires stressed in direct tension and to localised changes in form of wires in future, such sharper bends at weak points.

Gentlemen, while visiting various Paper Mills, common defects as observed in various Mills have been listed below which again needs special attention and study for its failure reason. We shall discuss each point separately now and I want your valued suggestions in this respect :

1. Wire Wrinkling.
2. Wire Ridging.
3. Wire Creasing.
4. Wire Scaling, Filling, Scoring.
5. Wire Spliting Distortion.
6. Wire Edge Crack, Corrosin.
7. Wire Clogging, Seam Clogging and Galvanic action on seam etc., etc.

In recent years when claims have been made on wires because of short life on the machine, it has been the practice for the manufacturer to ask for the return of the damaged for failed wire. Mills at first were reluctant to accept many of the conclusions brought out by the manufacturers regarding the causes for failure. But many Paper Mill staff realise the real value the wire manufacturer gains from the inspection of these used wires, and that through this medium of exchange of comments and ideas improvement in wire life may be achieved Further, it will be only through extended research in following out the individual problems will only improve the production of Fourdrinier Wires. The paper Mills and the wire manufacturers must work hand in hand in observing the operation of the Fourdrinier Wires.