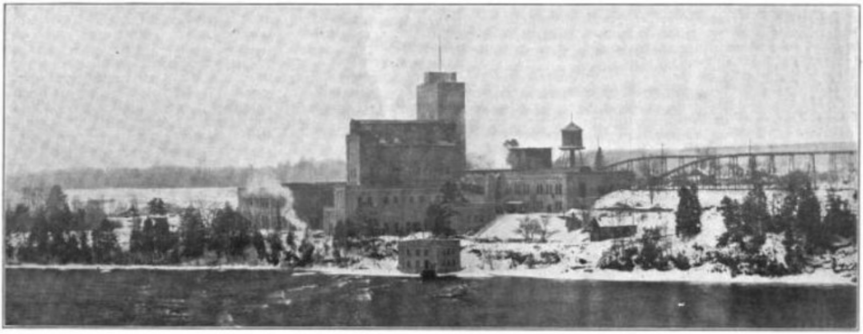


General View of the Fenimore Sulphite Pulp Mill.

# THE FENIMORE SULPHITE MILL.

THE NEW PLANT OF THE UNION BAG & PAPER COMPANY, NEAR SANDY HILL, N. Y.

The Union Bag & Paper Company is the owner of plants at Sandy Hill and Ballston, N. Y., Watertown, Mass., and Kaukauna, Wis., where it produces various grades of manilla and wrapping paper, and manufactures paper bags of an infinite variety of forms and sizes. The Sandy Hill mills furnish a large amount of stock pulp, which is shipped to the other mills for working up into finished product. The new sulphite mill which is to be described is located at Fenimore, on the west bank of the Hudson River, opposite Sandy Hill. A short distance to the north is a cutting-up mill and a ground wood mill operated by water power obtained from a dam crossing the river at this point. On the east bank of the river at the opposite end of this dam is another ground wood mill, while on the same side of the river and about three-quarters of a mile nearer the town, is a group of paper mills where the finished product is made. These are located at Baker's Falls, where an abrupt fall of over fifty feet exists in the river bed. At this point the natural head has been increased by building a second low dam on the crest of the Falls giving a total of sixty feet, which is utilized in a new hydraulic power plant generating high-tension electric current for transmission to the various factories and mills in the immediate district. The equipment will ultimately comprise three units of 1,200 horse-power each, but only 2,400 horse-power is available at the present time. This hydraulic plant operates the entire power equipment of the new sulphite mill at Fenimore, paper machinery in the group of mills at Baker's Falls and all the bag machinery of the bag factory.

At the Fenimore mills there has been installed for increased security against interruption of service, an auxiliary steam plant of 1,000 kilowatts capacity which receives steam from the boiler plant serving the sulphite mill, and during dangerous periods of high or low water this plant is kept continually in readiness for immediate operation. The plant consists of a single 1,000 kilowatt direct-connected unit, generating current at 660 volts, which completely relays the hydraulic service at the Fenimore mills. The power system is also arranged so that current may be generated at Fenimore and transmitted back to the hydraulic station at Baker's Falls in cases of extreme emergencies.

*Preparing Chips.*—With the exception of the steam supply to this auxiliary plant, the entire steam service of the Fenimore mill is utilized in connection with the sulphite process of wood pulp making. The pulp is made from spruce from the Adirondack region, which is floated down the Hudson River in the log. At the cutting up mill these logs are reduced to 2-foot lengths and transported by a conveyor on an elevated wooden trestle either directly to the wood room or to a storage pile. The delivery of 2-foot sticks is confined to those months when the logs may be driven down the river. The height of the conveyor trestle is 40 feet and it is 2,500 feet in length, furnishing a large storage capacity for the blocks beneath. In the winter time the wood in storage is elevated to the trestle conveyor by movable vertical conveyors, similar to those used in handling barrels. The vertical conveyor is driven by an electric motor which is connected by flexible wires to a power circuit extending along a trestle. The trestle conveyor was furnished by Garland & Company, Bay City, Mich.

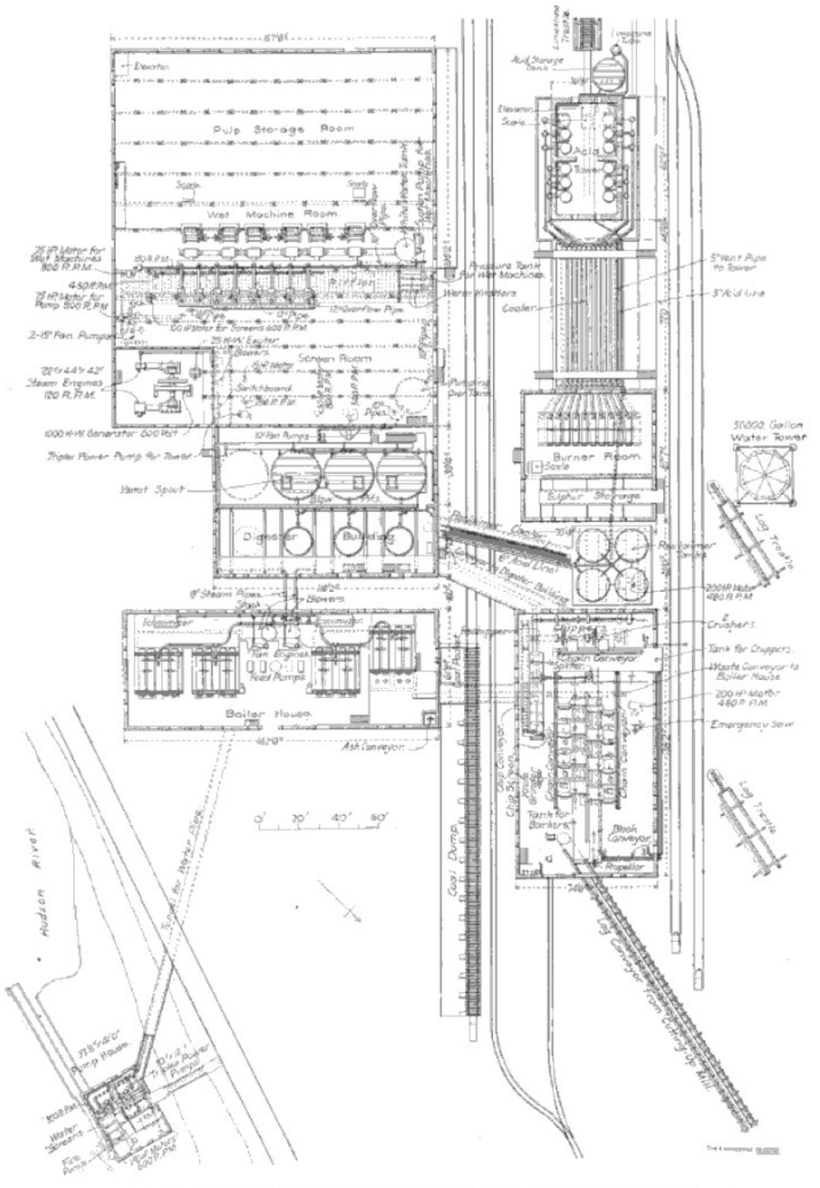
On reaching the wood room the blocks are dumped into a water tank which is heated in winter to remove the snow and ice. The blocks are floated through the tank, much of the dirt being washed off, and are then carried by a conveyor over the tank to the barkers, which are fourteen in number and built by the Sandy Hill Iron & Brass Works. The barked blocks are thrown on a flat chain conveyor and delivered into a second tank, from which they are delivered by a similar conveying apparatus to two Holyoke chippers in which they are reduced to pieces of suitable size for cooking. The chips drop through the floor and are broken up by a Lombard crusher, one being located below each chipper. The entire product falls into a belt conveyor which delivers the material to an inclined conveyor with maple flights, delivering the chips to an inclined Lombard chip screen.

The first section of this screen permits the sawdust to drop into a worm conveyor carrying this refuse to a belt in the basement. Chips suitable for pulp fall through the lower section of the screen and are carried by a series of belt conveyors to the digester building and then upward to the chip bins to which they are distributed by a Robins conveying belt with automatic movable tripper. The refuse that is refused by the screens drops into a tank in the basement and the chips which float are put through a Short rechipper and sent back to the screen. The knots which sink in the tank are delivered to the refuse belt. All refuse from the barkers, splitters, screens, etc., is carried by belt conveyors to the power house where it is used as fuel under two boilers.

The chips stored in the bins of the digester building are dropped through openings in the tops of the digesters, the connection between the bin and digester being made by a galvanized iron spout mounted on a trolley so as to be movable from one digester to another.

*Acid Making.*—The sulphur is delivered in box cars and wheeled to a gallery in the storage building from which it is dumped to the floor, often being stored to a depth of 30 feet. It is wheeled from the storage pile in a standard iron charging car to the burner room and shoveled by hand into ten burners built by the Portland Company, Portland, Me. The burning gases pass through the wall in cast iron pipes which drop into and connect with 10-inch lead pipes, 70 feet long and covered with water, in a long concrete tank built out of doors. At the far end the cool gas is piped into the bottoms of wooden tubes containing limestone located in the tower building. Arrangements are made so that the pipes between the cooler and the towers may be sprayed with water in unusually hot weather. The tower building contains ten wooden tubes 5½ feet in diameter and 145 feet high, each of which is fed independently from a single burner. All of the tubes are supplied by water from two tanks on the roof.

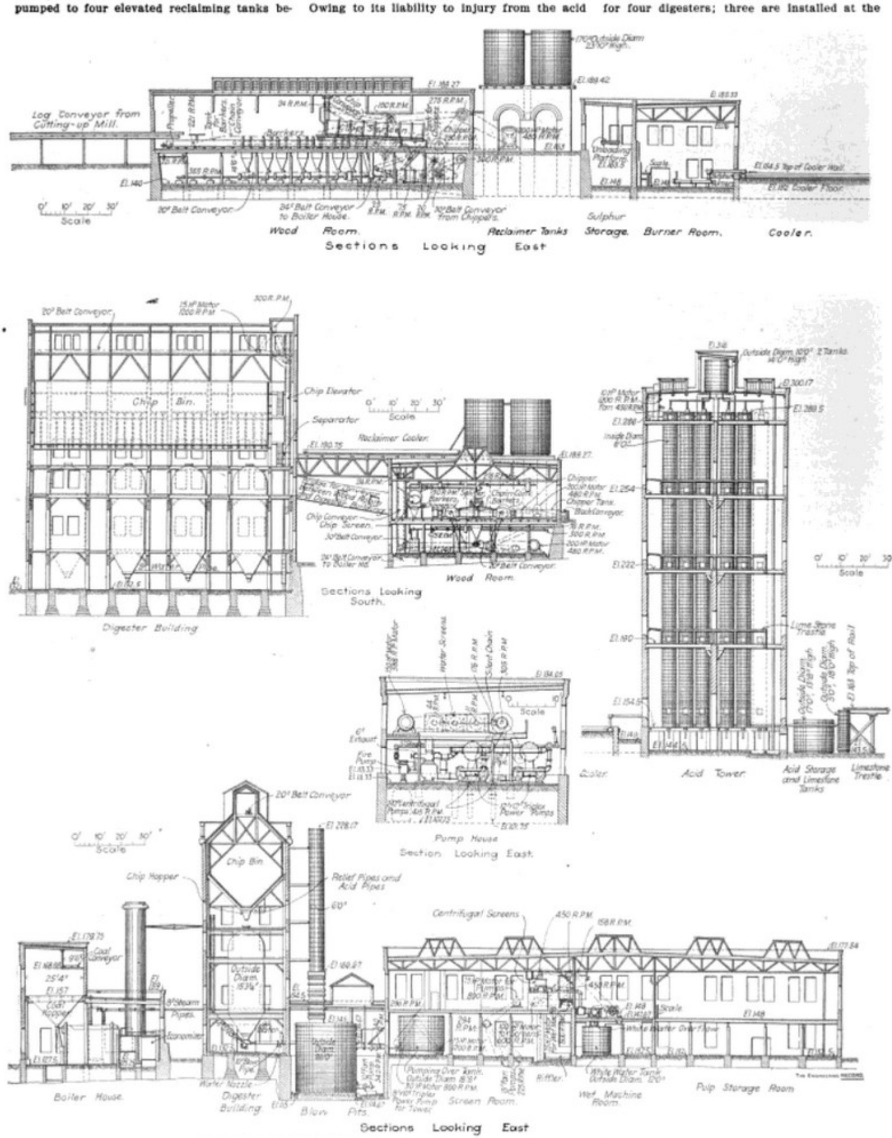
The limestone used is waste marble from Vermont. It is dumped directly from the cars on an elevated wood trestle and is loaded from the storage pile into narrow gauge cars and run into an elevator by which it is lifted to low trestles on each floor of the tower building where it is dumped to the charging floors. The sulphur gas enters the towers at the bottom and passes up through the limestone




GENERAL PLAN OF THE FENIMORE SULPHITE MILL, UNION BAG & PAPER COMPANY.

which is sprayed with water. The limestone is slowly decomposed and the sulphite liquor is collected at the bottom, whence it flows to a storage tank out of doors. From this tank it is pumped to four elevated reclaiming tanks between the wood room and the sulphur room. The upward current through the tubes is assisted and regulated by a bronze exhaust fan electrically driven and located in the attic. Owing to its liability to injury from the acid fumes no steel is used in the construction of this building, which is built of heavy Georgia pine timber with brick walls.

*Digester Building.*—This building has room for four digesters; three are installed at the



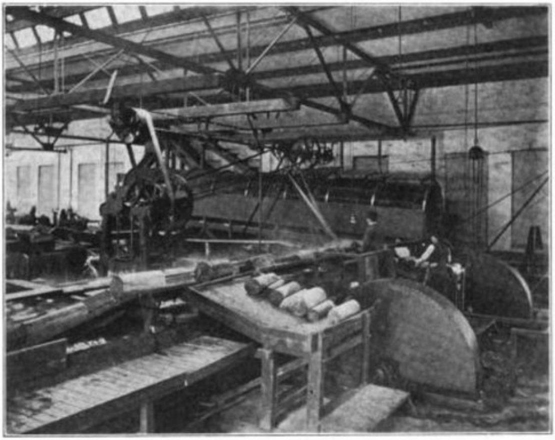

SECTIONAL ELEVATIONS OF BUILDINGS OF THE FENIMORE SULPHITE MILL.

present time. They were made by the Manitowoc Steam Boiler Works. Each is 15 feet in diameter and 50 feet high, built of 1⅛-inch steel plates with triple-riveted butt straps of 1¼-inch material. The digesters were tested when completed to 150 pounds hydraulic pressure and made tight at that pressure. They were then lined with lead with burned joints which were carefully tested and made tight, and inside of this a lining of acid proof bricks was then provided to withstand the mechanical action and also to some extent the action of the acid with which the digesters are filled. The lining was done by the Non-Antem Company, New York, and the lead work was furnished by the Raymond Lead Company of Chicago.

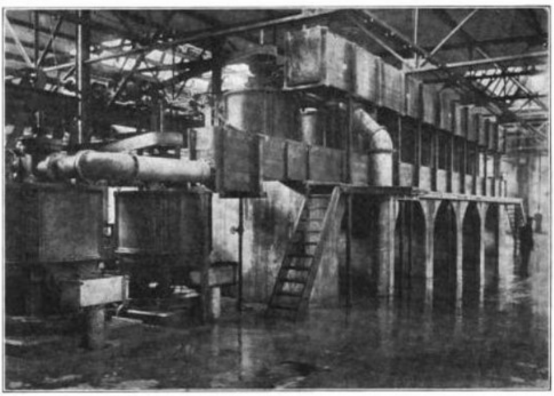
The acid storage tanks are elevated so that their contents flow by gravity through an 8-inch pipe into the digesters, which can thus be quickly and easily filled after they are charged with chips.

*Pulp Making.*—After the wood is properly cooked, as determined by tests made from time to time, the contents of each digester are blown under pressure into a corresponding wooden blow pit or tank, furnished by the Williams Manufacturing Company of Kalamazoo. Each of these is 26 feet in diameter and 30 feet high. A quantity of water, equal to the liquid contents of each digester, is forced under pressure into these discharge pipes when the contents of the digesters are blown out, thus condensing the gaseous fumes and avoiding the usual strong odor in the vicinity of sulphite plants, while at the same time preventing the escape of pulp which would be carried up through the vapor pipe if this arrangement had not been provided. The bottoms of the blow pits are perforated and the waste liquid from the washing is drained off and passed through an 18-inch sewer pipe into the river, about 2,000 feet down the stream from the mill.

The washed pulp is pumped to a small storage tank, marked "pump-over" tank in the drawings, from which it flows to the riffler in the basement of the adjoining screen building. Most of the centrifugal pumps for such purposes in this mill were furnished by the Morris Manufacturing Company. At the delivery point all the pulp passes through copper washers where the large and uncooked knots are discarded, to be afterwards ground and used in the manufacture of a cheap grade of wrapping paper. The remaining pulp flows through the riffler to the far end, and on the way more or less sand, dirt and foreign substances are deposited, these being removed weekly and thrown away. The product is pumped to the story above where it is delivered into a series of Baker & Shevlin rotary screens. The pulp that passes these screens is made into sheets in a group of six Bagley & Sewall wet machines and is then folded for shipment.



View in Wood Room, Showing Chippers and Chip Screen.



View in Screen Room, Showing Rotary Screens.

The refuse from the rotary screens is subjected to two other screenings which produce an inferior grade of pulp.

*The Power Plant.*—The boiler house is located a short distance from the digester building, where most of the steam is used. The building is approximately 160 feet in length, 60 feet in width, and on the north side where the coal bunkers are located, is 50 feet in height above the boiler room floor. The south half of the building, however, is but 30 feet in height, no extra head room being required there for the the steam piping, which is suspended a short distance above the boilers from the steel roof. There are four batteries of boilers arranged on each side of a central area where the feed pumps, stack and mechanical draft outfits are located. In the rear of the boilers the smoke flues and economizer chambers extend throughout the length of the batteries. The latter are placed next to the building wall so as to leave a passage about 7 feet in width in the rear of the boilers. In front of the boilers a 16-foot passage provides ample space for cleaning. Along the center of the room is a row of Z-bar columns surmounted by 36-inch plate girders, which support the south wall of the coal storage loft, the roof and half of the weight of the coal bunkers. A second and parallel line of columns, with 20-inch plate girder stringers adjacent to the outer wall, but entirely independent of the brickwork, carries the remaining weight of the bunkers. The bottom of the coal bunkers is formed by a series of six pyramidal steel hoppers, one to each boiler, these hoppers being suspended from transverse 24-inch girders carried by the columns above mentioned. In the upper part of the coal loft is a runway supporting the discharge leg of the coal conveyor, which is of the scraper type and elevates coal to the bins from a hopper, located between the tracks of the coal siding paralleling the west wall of the building. When the bins are filled, the coal siding itself, part of which is built on trestle, is utilized for coal storage, from which the coal may be transferred to the conveyor system by a secondary conveyor extending underneath the storage trestle.

In the extreme northwest corner is an ash tower rising to a height of 65 feet and containing a bucket elevator for raising ashes from the basement to such a height that they may be conveniently discharged into an empty car awaiting upon the coal siding. The elevator is driven by an induction motor, located in

the top of the ash tower, the necessary speed reduction being retained through belt and worm gearing.

A 7x7-foot tunnel extends throughout the length of the building underneath the boiler floor, and immediately in front of the boilers. This tunnel communicates with the ash elevator mentioned above and through it ashes are removed from the ash pits underneath the stokers. This work will ultimately be done by a conveyor, but is now accomplished by hand. No ash storage capacity is provided other than that already furnished by the ash pits and ash tunnel. The latter has a concrete floor and roof and ashes may readily be raked out of the ash pits through openings in the wall and stored until such times as it is found convenient to remove them.

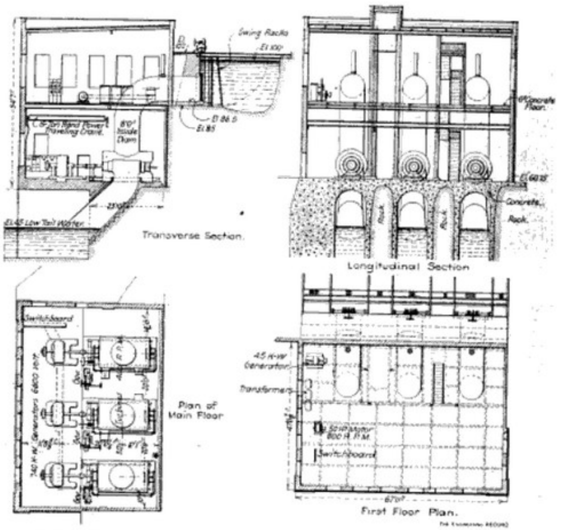
The total capacity of the plant is 2,400 horse power divided between four batteries of two boilers each. Both coal and wood is used for steam fuel; the former is buckwheat anthracite and the latter is in the form of shavings, bark, knots and refuse chips from the wood mill as before mentioned. Three batteries of coal boilers have been installed, each consisting of two 300 horse-power Aultman & Taylor water tube boilers. The wood burning battery consists of two 300 horse-power boilers of identical type. These wood boilers are fired by means of special furnaces of "Dutch oven" construction, and in order not to encroach on the passage in front of the boilers, this battery has been set back about ten feet, the width of the ovens.

Steam is generated at 150 pounds pressure for use in the auxiliary steam plant and is reduced in pressure for the digester plant. The safety valves on each boiler are provided with discharge pipes leading through the roof, so that the boiler room will not be filled with steam at an occasional blowing of the valves. The boiler blow-offs are piped to the passage in the rear of the boilers where all valves are readily accessible.

The feed water is obtained directly from the river, but before entering the boilers is first clarified in a special combination filter-heater. The mineral constituents of the Hudson river water cause little trouble from incrustation, but a large amount of vegetable matter is usually present. The apparatus consists of a vertical boiler shell about 23 feet in length and 6 feet in diameter, assembled in five sections with flanged heads at top and bottom. The top section contains a filter bed of cocoa matting, sponges, etc. The three sections below constitute a tubular heater of the conventional type, and at the bottom is a receiving chamber. The feed water enters at the top where the suspended matter is removed by the filter bed. It then passes through the heater tubes and from the bottom chamber directly into the feed pump suction. The heater sections are supplied with exhaust steam from feed pumps, fan engines and stoker engines, thus conserving the entire amount of waste heat from auxiliaries. The filter bed is renewed from time to time through suitable manholes provided in the shell. The three feed pumps are of the compound Wo'hington outside packed plunger type, cross-connected throu;h both steam and water piping for relay service.

The three batteries of coal boilers are equipped with Roney mechanical stokers arranged for burning buckwheat anthracite coal. The stokers for the two main batteries are operated from a single driving shaft, extending throughout the length of the batteries and driven through worm gearing by a small Westinghouse standard engine, mounted on an independent brick pier at the end of the battery. The ash pits are concrete lined and slope downward to openings beneath the stoker fronts, through which the ashes may be raked out into barrows or ash cars in the ash tunnel, as before mentioned.

The wood burning battery is fitted with two Dutch ovens, approximately 8 feet in depth and of the same width as the boiler front, 10 feet. The ovens are provided with horizontal grate bars of close design and ordinary boiler fronts with fire and ash pit doors. The shavings are received through a shaving conveyor from the wood mill, and charged into the furnaces from an elevated platform through 20-inch round openings. Each furnace has two firing holes and the two sides are fired alternatively to reduce as much as possible the quenching of the fuel bed by large quantities of wet bark and shavings. No difficulty is experienced in maintaining a uniform steam pressure with this fuel, and it is found that the wood burning boilers supply a considerable portion of the total steam required for the operation of the mill.




**Fenimore Sulphite Mill: Plans and Sectional Elevations of Hydraulic Power House.**

The arrangement of flues, economizer settings and mechanical draft outfits is clearly shown in the accompanying engraving, and provides for the operation of either half of the boiler house equipment by either fan and with or without its economizer. There are two Green economizers installed, with provision for a future third. They are of the improved circulating type, manufactured by the Green Fuel Economizer Company, under the patents of Westinghouse, Church, Kerr & Company.

Draft for the boiler plant is mainly furnished by two 180-inch exhaust fans built by the B. F. Sturtevant Company from the special designs of Westinghouse, Church, Kerr & Company. The fans are of the three-quarter-housed type and occupy the space between the boilers in the center of the boiler house. The fans exhaust the burned gases from the collecting chamber immediately in the rear, and discharge them into a steel stack, mounted directly upon the top of the fan hoisting, which is strengthened by structural sections for this purpose. The stack is 8 feet in diameter and 70 feet in height, and is constructed of ¼-inch and 3-16-inch steel, with single riveted joints. It rests on and is bolted to a 4x6-inch angle flange riveted to the top of the fan housing. At its lower end is a short uptake which changes the section from a 6x8-foot discharge opening in the top of this housing to the circular section of the stack. The stack is braced near the top by a horizontal combined strut and tie anchored in the wall of the adjacent building.

The high-pressure steam piping is characterized by the absence of expansion joints, separators, traps and returns. The entire system is pitched back to the boilers at sufficient slope to return condensation automatically without the employment of special apparatus. Long radius sweep bends have been employed to provide the necessary flexibility for expansion and contraction. The piping system is suspended by adjustable iron hangers from the steel roof beams of the boiler house, and is anchored at the center and two intermediate points. Walworth valves were employed and the Walmanco pipe joint was used.

The steam mains from the two halves of the boiler room converge to a central distributing point, where a short cast-iron manifold header is located, from which extend the various supply lines to the digester building, the auxiliary engine plant and the auxiliaries in the boiler room. Screw and yoke valves located upon either side of the manifold header and also in the riser, from each boiler battery provide adequate means for proper manipulations of the boiler equipment and the isolation of a defective section of piping. All high-pressure steam lines are protected from excessive radiation by magnesia pipe covering.

A striking though comparatively unimportant feature of this plant is the effect produced by the judicious use of aluminum and other paints. The coal hoppers, chutes and stoker fronts, feed water heater, fans, stack and steel work, are finished with black graphite paint, while the boiler fronts and drums, stoker engines, fan engines and feed pumps are finished in aluminum. The building walls and boiler settings are stained with a subdued color to a height of 5 feet from the floor, and the remainder, including the roof of the south half, is finished in white. The effect of this simple decoration in addition to the white pipe lagging is extremely effective and lends an appearance of cleanliness which might well be given consideration in more pretentious boiler rooms. The aluminum paint has been used throughout the works at Sandy Hill for finishing steam, hydraulic and electrical machinery with the most satisfactory results.

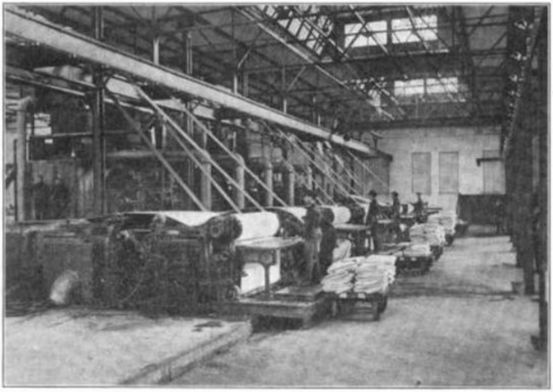
The general water supply for the entire premises is obtained from a two-story pump house, 32 x 40 feet in plan, located on the bank of the river. The first floor of this building is just above high water level. It is connected with the boiler house by a concrete tunnel through which pass all pipes leading to and from the pump house. These pipes are suspended from iron supports attached to vertical wooden posts securely anchored in the concrete wall of the tunnel. The water supply is drawn from a concrete penstock beneath the floor communicating with the river through suitable racks. The water is elevated by two 12-inch centrifugal pumps to a reservoir on the second floor containing three rotary screens which remove the wood chips and vegetable matter that are not of sufficient size to be caught by the racks. The water is drawn from these tanks by power pumps which discharge into the distributing system. The pumping equipment consists of three Gould 10x12-inch triplex pumps belted to an elevated countershaft driven by a 200 horse-power induction motor. The pump house also includes one 1,500-gallon Worthington underwriters fire pump supplied through a 5-inch steam line from the boiler house. All pumps connect into a 12-inch water main with branches supplying all buildings and a 5,000-gallon water tank elevated 50 feet on a steel tower some distance from the buildings.

The electric power for the operation of all of the mills is located on the opposite bank of the river about one-half mile distant. The power-house is built close to the river bank in an excavation blasted out of solid rock. Water is taken from the canal heretofore used by the company at its mills located at that point. Fine and coarse racks are used to prevent obstructions from entering the turbines. The water passes through the canal above through wooden gates to steel penstocks 8 feet in diameter each connecting with a pair of 30-inch McCormick turbines built by the S. Morgan Smith Company, of York, Pa. Each pair of wheels discharges through a central draft tube into the river below. Lombard water wheel governors are attached to each pair of wheels.

Each pair of turbines is connected to a 750-kilowatt three-phase 6,600-volt generator with the exciter armature mounted on the end of the generator shaft and overhanging the main bearings. Two generators are installed at the present time, but all other work has been done for the installation of a third. A traveling crane spans the generator room for handling the heavy machinery. The transformers and other devices for furnishing the working current at 600 volts are located in a sub-station in the sulphite mill, although there is a small transformer station in the second story of the power-house where current is transformed for use in the vicinity. As before stated the hydraulic power can be replaced by the steam plant in the sulphite mill at times of low water. This plant consists of a cross-compound Hamilton Corliss engine driving a 1,200-kilowatt generator at 600 volts.

The motors are of the induction type, and that they may be interchangeable to some extent as few sizes as possible are used. The entire electrical equipment was furnished by the General Electric Company, and installed under supervision of Mr. A. R. Bush, of Boston.

The buildings are of brick and steel construction with concrete floors and roof reinforced by expanded metal. They were erected by Grace & Hyde, the steelwork being supplied by the Penn Bridge Company. The plant covers about twelve acres, exclusive of saw mill, conveyors and wood storage, and was completed in November, 1902. The buildings and the entire equipment were designed by the company's engineering force. Mr. E. G. Barratt, now the vice-president of the company, was at the time of construction in entire charge of the work, and was assisted by Mr. M. O. Kasson, the present general superintendent of the company, and by Mr. R. B. Wolf, superintendent of the mill. Mr. H. A. Moody was in charge of all instrument work in connection with the construction of the buildings.



**View in Wet Machine Room, Where Finished Pulp is Produced.**

## Engineering Problems in Tanneries.

Tanning is a most interesting industry to the engineer and chemist, because it is largely secret. Each company keeps its methods and its mechanical equipment as closely guarded as possible, and even when specialists are called in for advice, it not infrequently happens that they are refuseu admittance to some parts of the works they are visiting. For this reason, special interest attaches to a paper read a few months ago before the Michigan Engineering Society by Mr. Byron E. Parks, and recently published in its proceedings. The entire paper is too long to reprint in this place, but the following extracts from it indicate what an advantage such a close industry as tanning will derive from the services of an engineer and chemist who is permitted to make a really thorough search for opportunities to introduce improvements.

Hemlock bark is the principal tanning medium used by all tanners of heavy leather throughout the Northern States, and is the largest single item of cost in the operation of a sole leather tannery. Investigations made a few years ago indicate that bark pitched in the leaches as "spent tan" still contained a considerable strength of tannin; in fact, analyses of numerous samples showed that they still contained from 5 to 7 per cent. of tannic acid. Bark taken from forests in the mountain districts of the Eastern States shows when air dried an average of 8 to 10 per cent. of its weight in tannin, while bark taken from the forests of Michigan and Wisconsin contained from 10 to 12 per cent., and some samples analyzed have shown as high as 15 per cent. of tannin. A comparison of the values shown by the analysis of the "spent tan" and of the bark in its original state as taken from the tree, indicates that about half the strength had been wasted.

Formerly it was the practice to leach bark at low temperatures, or with practically cold water. One reason for this was the want of adequate means of neating the large volume of water required in the time allowance, and the other and principal reason was that those who had tried higher temperatures found that a coloring matter called "the reds" was dissolved and extracted from the bark. This darkened the tanning liquor and gave an undesirable color to the finished leather. When the chemist demonstrated to a certainty that about half the bark consumed was a waste, and when the growing scarcity led to increased cost, the progressive tanners were ready to consider any feasible means of reducing their bark consumption. Here the chemist came to their aid and gave them a system of bleaching leather after the tanning process was complete, by means of which the desired color could be given it, whatever its color may have been when taken from the vats.

With the advent of the bleaching system came the engineer's problem to provide an efficient means of heating the required volume of water or tan liquor to a temperature approximating 212 degrees, and maintain it at tnat temperature during the process of leaching. The earliest form of heater was a box coil built up of brass tubing surrounded by a wooden box