

CHELSEA CENTER FOR RECYCLING AND ECONOMIC DEVELOPMENT

UNIVERSITY OF MASSACHUSETTS

Technical Report #15

**CREATIVE PAPER, INC.
WASTE PAPER RECOVERY PROJECT**

**In support of the Massachusetts Recycling Initiative to
Recycle Recovered Waste Paper**

February 2000

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**Chelsea Center for Recycling and Economic Development
Technical Research Program**

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The Chelsea Center for Recycling and Economic Development, a part of the University of Massachusetts' Center for Environmentally Appropriate Materials, was created by the Commonwealth of Massachusetts in 1995 to create jobs, support recycling efforts, and help the economy and the environment by increasing the use of recyclables by manufacturers. The mission of the Chelsea Center is to develop an infrastructure for a sustainable materials economy in Massachusetts, where businesses will thrive that rely on locally discarded goods as their feedstock and that minimize pressure on the environment by reducing waste, pollution, dependence on virgin materials, and dependence on disposal facilities. Further information can be obtained by writing the Chelsea Center for Recycling and Economic Development, 180 Second Street, Chelsea, MA 02150.

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Acknowledgements

The Merrimack Valley Manufacturing Partnership (MVMP) wishes to thank Creative Paper, Inc. and participating equipment suppliers for their support in preparation of this report. Creative Paper, Inc. deserves special recognition for their commitment and determination to solve the problems associated with processing lower grade waste paper.

The Chelsea Center for Recycling and Economic Development provided financial support for this project because of its potential to increase the utilization of lessor quality recyclable paperboard that is becoming a serious disposal problem for the Commonwealth of Massachusetts. MVMP, CCFRED, Mill Hill Engineering Ltd., and equipment vendors provided technical support to Creative Paper to implement this project. Creative Paper, Inc. was selected because they are a prime resource for the utilization of waste paper and demonstrated the ability to implement this project.

Personal recognition and much credit for their active role is given to Jodie Siegel (CCFRED), Dave Porter and Chris Booth (Creative Paper), and Fran Eagle (MVMP).

1. Abstract

The presence of a wide variety of contaminants in recycled paper feedstock has proved to be an impediment to developing markets for recycled paper products. This situation had restricted Creative Paper, Inc.'s ability to use a broad spectrum of recycled paper as raw materials in the production of corrugated medium and bottom liners. Through funding for this project from the Chelsea Center for Recycling and Economic Development and with technical assistance from the Merrimack Valley Manufacturing Partnership, Creative Paper, Inc. was able to redesign its manufacturing processes to overcome these hurdles. The goal of this project was to enhance the capability of Creative Paper, Inc. to utilize a lower grade of recyclable mixed paperboard as a feedstock in its processes. It was anticipated that if this objective was reached, production could be increased 44% and result in substantial cost savings due to the reduced cost of the lower quality recycled feed stock.

The goal was achieved by:

- automating the present pulper reject dumping procedure,
- identifying and installing alternative equipment systems capable of filtering and screening out contaminants such as plastic and other non-fibrous materials more efficiently, and
- installing a recirculation system which more efficiently separates usable fiber from poly-coated papers and other mixed recovered waste paper.

These changes resulted in a more efficient and cost effective separation and pulping process which allowed the mill to increase its paper machine production by more than thirty tons per day.

This report details the process changes and equipment selections that were made as a result of this project.

Background

Creative Packaging, Inc. a manufacturer of corrugated boxes and located at 175 James St. in Worcester, Massachusetts, is a robust twenty-five year old company with approximately \$13 million in annual sales. The company is middle-sized and independently owned by James E. Hamilton, President of Creative Packaging, Inc. and its Vice President, Richard M. Perlman. The partners' dream was to manufacture boxes - a dream they pursued and fulfilled. Richard Perlman and James Hamilton decided to vertically integrate their business by first manufacturing the paper which would then be used to produce the boxes. After much research, Creative Paper, Inc. was formed to produce high quality corrugated medium and bottom liners using a waste recovered boxboard material. These materials are used by Creative Packaging in their own boxboard production and as a market supplier to other boxboard manufacturers.

Prior to this project, Creative Paper, Inc. was restricted to using a limited selection of high-grade sorted paperboard and old corrugated containers.

The Chelsea Center for Recycling and Economic Development provided funding to cover some of the costs of technical services required to evaluate the specific equipment alternatives that would enhance the paper mill's ability to screen out contaminants more efficiently and to more fully automate its processes.

The proposed new system was designed to more efficiently screen out plastics and other non-fibrous materials found in lower-grade mixed recycled paperboard. To determine the feasibility of the new process, cost estimates were prepared and preliminary engineering performed to determine the best approach for integrating the new equipment with the existing system. Integration of the existing stock system with the pulper re-circulation system was most critical since maximum fiber separation from contaminants was the key reason to modify the pulper system and essential to increase product throughput. By making the proposed changes in the old system through improved screening and by altering the cleaning process around the pulper, the mill's ability to remove greater volumes of contaminants would be enhanced and higher levels of fiber would be recovered.

The proposed process and equipment changes around the pulper system appeared to be cost effective and would permit the mill to increase paper machine production in excess of thirty tons a day. The changes would allow the mill to use a lesser grade of mixed paperboard normally considered curbside mixed paperboard. The ability to use a lower cost mixed paperboard and the increased paper machine production provided the economic justification to capitalize the project following the feasibility review.

One of the major factors limiting Creative Paper, Inc. from further expanded use of recycled feedstock is dealing with the increased volumes of contaminant.

Increased use of mixed recovered paper is possible with the new process changes because of the greater efficiency with which contaminants are removed. This creates new challenges to address increased solid waste disposal demands. Using more mixed recovered paper increases the overall volume of contaminants. The volume can vary greatly with each bale of mixed waste and result in an overall increased volume of solid waste requiring disposal.

Problem Statement

During the initial startup phase, Creative Paper, Inc. encountered a number of problems in the removal of plastics and other contaminants. The contaminants ranged from laminated plastics, box staples, adhesives, Styrofoam food containers and other unwanted materials. In addition to the technical problems associated with the separation and removal of these contaminants, there were additional challenges as a result of the increased volume of waste materials that accompanied the recycled waste paper.

Scope of Work

The goal of this project was to enhance the capability of Creative Paper, Inc. to utilize a lower grade of recyclable mixed paperboard as a substitute fiber source to supplement old corrugated container recycled paper (OCC). To accomplish this objective, major modifications to the pulping system were required. Additionally, key changes to the stock system were needed to deal with the high level of contamination in the lower grade of recycled material. Since the paper machine process system is integrated with the pulping system, major flow modifications of the white water recycle system were also necessary. The scope of this project was to design and implement an integrated process that would completely remove contaminants before the pulp reached the pulp stock thickener machine that supplied the paper machine.

The following tasks were defined for the project:

- Determine final equipment selection and design requirements for proposed integration into the existing process system
Approach: New equipment selection began at the feed to the pulper where recovered old corrugated containers (OCC) are fed through to the thickener that feeds the paper machine.
- Determine final equipment purchase and design/construct installation cost estimate
Approach: Creative Paper, Inc. selected Mill Hill Heavy Engineering LTD to work with in-house staff to assess and redesign the pulping system on a fast track construct basis as an approach that would reduce downtime for the modification changes as well as reduce design/construct cost. Mill Hill provided Creative Paper with equipment selection and installation cost estimates.
- Install Recirculation System
Approach: Piping modifications were made by the use of in-house staff and local contractors. One of the unique features of Creative Paper, Inc. is that it does not discharge process wastewater because it uses a 100% closed loop process water system.
- Update present process flow diagram and procedure manual for proposed modification
Approach: Rather than update existing process flow diagrams and revise fiber and water balances, the mill used the vendor equipment drawings and process flow specifications to fast-track the installation and start-up procedure. Mill Hill Engineering's staff provided on-site start-up and procedures training to Creative Paper, Inc.'s staff. Training manuals will be prepared at a later date if needed.

Implementation of Scope of Work

The actual work on this project consisted of analyzing the processes, determining the final equipment selection and design requirements for integration of the modifications into the existing process system.

1.a Description of the Separation and Removal Process and Problems

Before the rebuild of the stock system, there was no means of extracting contaminants from the pulper. This required shutting down the pulping operation every twenty-four hours to remove plastic manually. The contaminants, which passed through the pulper with the pulp slurry, first passed through the high density cleaner where heavy materials, such as glass, metal, sand staples, etc., were extracted. The acceptable/usable fiber was then fed to a Black Clawson 24P-pressure screen that removed plastic and other contaminants not removed by the high density cleaner. When the bales were fed to the pulper, the bale wire was dumped in the pulper and a roper was used to create a whipping type action to attract the bale wire that acted as fingers grabbing onto large strings of plastic. The roper was attached to a winch, which pulled the large plastic to a truck hopper and was taken to a landfill. A large quantity of usable fiber was carried away in the process. The pulper also had a timed cycle for dumping rejects at the bottom of the pulper. The quantity of reject was so great however, that the dump valve could not dump the material fast enough. The level of reject would fill the pulper, which reduced the

pulper capacity and required the pulper to be shut down manually for cleaning. The rapid build-up of contaminants in the pulper, made it necessary to use DLK (Double Line Kraft) waste, which is a clean stock containing no plastics, metals or other contaminants. This meant it was also impossible to run mixed waste or any type of lesser grade of recovered waste paperboard. The critical impact of these problems was a loss of system capacity, major waste handling problems, increased manpower, and the need to compete for a clean high-cost recyclable feed stock, and increased waste material disposal costs.

Conclusion: Automate present pulper rejects dumping procedure

1.b Research Of Potential Solutions And Alternative Equipment Systems

The Merrimac Valley Manufacturing partnership (MVMP) was asked by the Chelsea Center for Recycling and Economic Development (CCFRED) to assist Creative Paper staff to help research potential equipment systems as discussed in CCFRED Technical Report #4, Papermill Recovered Waste Paper Survey. A meeting was set up with the mill staff by MVMP. The primary focus of the meeting was to provide technical expertise in an initial process assessment that focused on the stock system and pulper area. Representatives from Mohlin & Co. and Venturi Aeration Inc. also attended the meeting. The following topics were discussed and identified as target areas for redesign:

- ◆ The current procedure used to charge the pulper needed improvement because of OCC quality and contaminants.
- ◆ Loading the pulper at floor level entry is normally standard practice and with the present configuration of the building and pulper, re-engineering needed to be done in this area.
- ◆ Because the incoming bales have so many contaminants, the system needed a better way to remove rejects and reduce spillage and a better method of reducing volume by compacting the waste.
- ◆ Whitewater needed mechanical treatment and improved stock chest recirculation.

Conclusion: Contact equipment suppliers to identify equipment that could automate the pulper feed system, the rejects dumping procedure, and screen out plastic as well as reduce fiber loss.

1.c Mass Balance

A mass balance was undertaken for the process in order to obtain the approximate piping and equipment flowrates required to calculate piping sizing and approximate water consumption. A review of the piping system with the mass balance was completed to obtain an overview of the piping bottlenecks due to the increased throughput of the mill. This highlighted some piping modifications, which would eradicate minor problems currently experienced with the paper mill's operating conditions due to the increased throughput.

Design and Installation of New "Mill Hill" System

Mohlin & Company subsequently presented a draft proposal for engineering services for the installation of a scavenger and skip hoist on the pulper. Preliminary engineering and design work would include process engineering to determine equipment specifications, research and development of process control strategy, quotations for new equipment, general arrangement drawings for existing and new equipment and vendor cost estimate quotations (+/- 10%) for equipment purchase and installation. Based on the Mohlin design and engineering work, Mill Hill Heavy Engineering LTD was selected by Creative Paper, Inc. to provide the equipment on a design/install contract basis with local contractor assistance.

Primary Equipment Selected

The selection of equipment and their integration into the existing stock system was intended to achieve the following major objectives:

- To allow Creative Paper, Inc. to have the ability to use a lower grade of mixed recovered paperboard products;
- To feed bales of recovered mixed waste to the pulper on as continuous a basis as possible;
- To improve the ability to increase fiber yield by improving fiber separation from the rejected contaminants, plastic etc.; and
- To make piping improvements to enhance better control and circulation of the system white water used for thickening and dilution throughout the process.

The sequence of equipment selected for modification or new installation was:

- ◆ Pulper Feed Conveyor
- ◆ Automated Trash Compactor
- ◆ Sequence Controller for Trashex/Trommel
- ◆ Trashex*
- ◆ Trommel*
- ◆ Rotary Turbo Separator *
- ◆ Vibrating Screen*
- ◆ High Density Cleaner*
- ◆ Light and Heavy Rejects Valve
- ◆ Sequence Controller for Light/Heavy Rejects Valves

*Detailed descriptions of these pieces of equipment are presented below.

Major Equipment Descriptions

The following descriptions identify the major equipment modifications and new equipment installed as part of this project. Each of these pieces of equipment is identified and labeled on the attached Appendix A – Process Flow diagram. All of the equipment was specifically designed or selected to optimize the overall performance of the system. Some of the factors which were considered in the design and selection process included the type of furnish (raw materials) which would be used, the volume of throughput needed, the cleanliness requirements of the pulp, and the interface with other equipment choices.

1.d Trashex

The Trashex and Trommel operate as pulper cleaning devices. The Trashex is essentially a pump, which can move large heavy materials such as metal and wood and high-density pulp. The Trashex, which is situated underneath the pulper, pumps the materials to the Trommel, which is located above the pulper. Before the Trashex is operated, the beating time of the pulper is increased, to minimize the amount of unbroken clumped fibers, which are sent to the Trommel. Large clumps of fibers would not pass through the perforated Trommel drum and therefore would be rejected along with brick, pieces of wood, plastic, etc.

1.e Trommel

The Trommel is an inclined tapered perforated drum. The Trashex pumps the high-density pulp that came originally from the pulper to the Trommel. The Trommel screens the pulp and

allows acceptable water, fiber, and small contaminants to be gravity fed back into the pulper. To increase fiber recovery, the Trommel is slowly rotated to agitate the stock. Water is added to aid the fiber/contaminant separation. Two helical screws are welded inside the perforated drum. When the direction of the drum's rotation is reversed, large contaminants are rejected from the system as the helical screws force them out of the front of the Trommel. The hole size of the perforated drum was selected to maximize the separation properties and fiber recovery qualities of the equipment.

1.f Rotary Separator

The Rotary Separator uses centrifugal forces to stratify the stock into three regions, heavy rejects, light rejects and acceptable materials (accepts/fibers). Heavy rejects are forced against the outside wall, light rejects remain in the center, and acceptable materials (accepts/fibers) migrate to the region in between. Heavy rejects exit the Rotary Separator via a tangential pipe at the top of the machine. This enables them to exit at high pressure. No pump is needed to move them to the High Density Cleaner (secondary fiber recovery device). Light rejects exit through the center of the front of the Rotary Separator and sent to the Vibrating Screen (secondary fiber recovery device). The "accepts" remain within the Rotary Separator until they can pass through a perforated plate (screenplate). A rotor, which has minimal clearance above the screenplate, cleans it and also breaks fiber clumps into individual fibers, allowing them to pass into the accepts pipe behind the screenplate and send on for further filtering and refining. To reduce wear from heavy contaminants (glass, staples, sand, etc.), the outside wall and front of the Rotary Separator are lined with basalt tile which is a very highly wear resistant material. The pressure within the Rotary Separator is high enough that no pumps are required at any of the outlets.

1.g Vibrating Screen

The vibrating screen is the secondary cleaning device for the light rejects that consist of plastic pieces with fibers attached. A series of perforated plates screen the "light rejects" stream and the "accepts" from the Rotary Separator and return the recovered fibers to the pulper. The perforated plate hole size is larger than the screen plate hole size in the Rotary Separator since the latter is pressurized and the vibrating screen is open to the atmosphere. The perforated plates are mounted on springs with an eccentric shaft and offset drilled couplings, which puts a throw on the screen plates while the motor is operating. This rotating motion encourages forward movement of the contaminants, which are removed from the system at the end of the perforated plates. Water sprays are used to wash fibers from the plastic and this improves the fiber recovery process further.

1.h High Density Cleaner

The High Density Cleaner (HD Cleaner) is the secondary cleaning device for the heavy rejects stream which comes from the Rotary Separator. It uses centrifugal forces to separate the stock flow into heavy contaminants, which move to the outside wall of the cleaner, and "accepts" which remain in the center (similar to the Rotary Separator). Dilution water creates a still zone at the bottom of the cone, which washes fiber off the heavy rejects prior to dumping. Once the heavy contaminants enter the still zone, they drop to the bottom of the "rejects" chamber. After a specified period of time, the rejects chamber is isolated and the contents removed from the system. Isolating the rejects chamber allows continuous operation of the cleaner. The inlet to

the High Density Cleaner comes from an outlet pipe in the top of the Rotary Separator at a high pressure of about 30 psi. The “accepts” from the High Density Cleaner return to the center of the Rotary Separator at a low pressure of about 15 psi, which overcomes the 15 psi pressure drop which occurs within the HD Cleaner.

Project Outcomes

With the installation of the Mill Hill pulper cleaning system, Creative Paper, Inc. is now able to clean the pulper on the run with a continuous cycle, virtually eliminating the need to buy Double Line Kraft replacement pulp and allowing the company to run 30% mixed waste instead. The new system includes the Trashex, which pumps contaminants out of the pulper, and the Trommel, which reclaims useable fiber from the contaminants. Creative Paper continues to use the High Density Cleaner, but has replaced the Black Clawson 24p Screen with a Mill Hill Rotary Separator. Overall efficiency of the screening and cleaning has dramatically improved, reducing the amount of fiber lost from the system. Fewer contaminants enter the paper processing system, which results in a cleaner product and permits utilization of a dirtier furnish (recovered stock). The throughput has been increased to the point that the paper machine can not keep up with the stock preparation equipment. This is the opposite of the situation that existed before the modifications were made and the new equipment was installed. Reliability has improved, reducing the number of unscheduled shutdowns that can severely reduce overall throughput. Piping, pumps and motors have been rearranged to accommodate the new system, thereby reducing horsepower requirements as well. The automated waste compactor has also substantially reduced the volume of waste requiring disposal.

Summary of Technical, Environmental and Economic Benefits

Improved Process Efficiency:

- Greater up time due to fewer outages
- Improved contaminant removal
- Ability to use lower & less costly grades of recovered raw material
- Cleaner stock system with improved circulation
- Increased fiber recovery

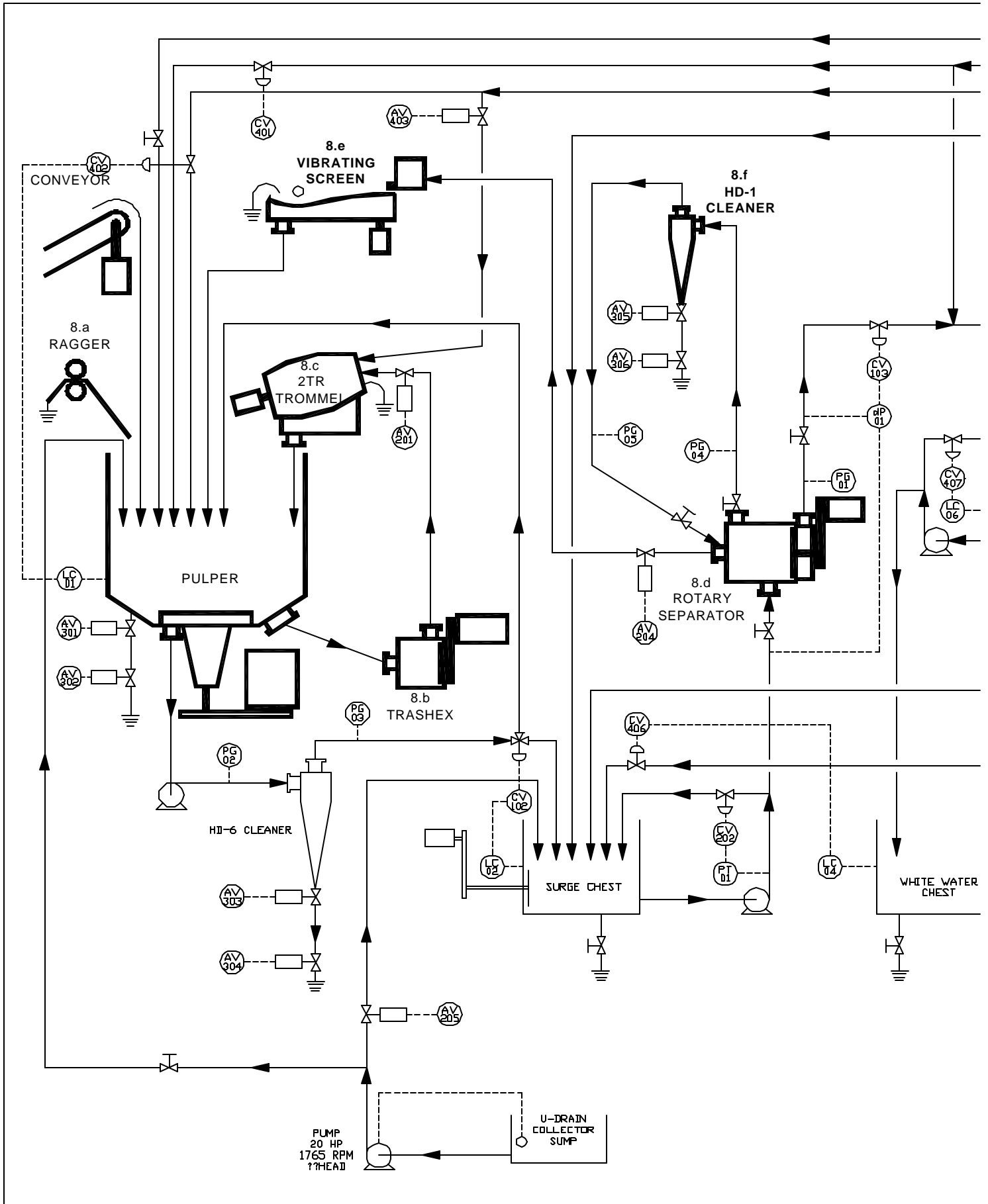
Environmental Benefits:

- Reduced water use
- Reduced system odors from dead areas in the stock and whitewater chest
- Removed contaminants that may have settled out in the stock chest and whitewater chest
- Reduced volume of solid waste requiring disposal through automated compaction

Economic benefits:

- Reduced operating and material costs
- More saleable product due to higher fiber recovery
- Ability to produce higher quality products, using a less expensive recovered recyclable paperboard that is widely available due to its low demand

APPENDIX A – Creative Paper Process Flow Diagram After Modification



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