Energy Saving Opportunities VIA Pulp & Paper Process Speciality Chemicals

Michael J. Stanbrough

INTRODUCTION

Energy in many mills around the globe is constantly in tight supply and is often subject to the whims of the world oil prices. For the purposes of this discussion energy will refer to hydrocarbon materials such as oil and gas, thermal energy in the form of steam, and electrical energy be it self generated or purchased. For the most part much of the pulp & Paper Industry depends on hydrocarbons for energy. Some mills are fortunate to have hydroelectric energy as a power source but they are in the minority. Fully integrated Kraft mills gather much of their energy from the recovery process where black liquor a by product of Kraft pulping is burned in a recovery boiler which then produces steam and electricity via steam powered generators. In any case energy and large quantities of it are required to manufacture pulp and paper.

In many parts of the world the cost of energy accounts for as much a one third of the total cost of manufacturing a ton of paper. Raw materials, fiber, chemicals, water, manpower, maintenance, and capital costs make up the other two thirds of the total costs. Since energy such a major cost most pulp and paper mills pay close attantion to its consumption. Accounting for steam consumption and electrical energy perton of paper produced is an every day measurement of efficiencies.

Major engineering projects and capital equipment investment should all have an energy component in their planning and financial accountability. Major investments are often made with the expressed purpose of reducing energy consumption. A new press section which increases web solids prior to the dryer section may cost millions of dollars and largely justified via the reduction in steam energy required to subsequently dry the sheet. Most mills increase production rather then save steam but non-the less the energy costs per ton of paper for drying are reduced. Similar projects can be found through out the paper process. Equipment companies continue to introduce new innovations every year and many of these proposed improvements result in reduced consumption of energy per ton of paper produced.

CONTINUOUS PULPING ENERGY SAVINGS

Contionuous cooking Kraft digesters often times will develop scale problems in the liquor heaters. This scale acts as an insulator thus reducing the efficiency of the energy transfer between the steam and the cooking liquor. Specialty chemicals are added to the cooking liquors, which control the scale formation thus improving the efficiency of the energy transfer. They all so reduce the frequency of down time to clean out these heat exchangers used to heat the cooking liquor.

The application of cooking aids in the Kraft process is becoming very common. Blends of digester additives are frequently used to improve the yields and reduce the reject levels. These applications results in small reductions in over all energy use as more usable tons produced at the same energy levels.

PULP WASHING SAVINGS

Kraft pulp washing is a multi stage process. Various arrangements of equipment such as drum washers, multistage table washers, or the newer multistage single drum washers all work off the same basic principles. Dirty pulp is introduced at one end and clean hot wash water is applied at the opposite

Nalco Chemical World Wide Technical Support Group
One Nalco Centre,
Naperville, Illionois- 60563-1198,
Area 630-305-1000 (USA)
(Through Nalco Chemicals India Ltd.)
20 A, Park Street, Calcutta-700 016

end. Pulp and wash water run counter current with clean pulp exiting the washers after the last stage of washing and water with high levels of black liquor solids exiting the process at the first stage of washing. The weak black liquor is processed through a series of evaporators prior to burning in a black liquor recovery boiler. The higher the liquor solids the less energy required to evaporate the excess water. Specialty wash aids are applied at the Kraft washers to reduce the demand for wash water thus resulting in clean pulp and weak liquor with higher solids. The net result is energy reductions in the evaporator process due to higher solids black liquor leaving the washers.

BLACK LIQUOR EVAPORATOR SAVINGS

Evaporators like cooking liquor heaters are known to form scales. When these scales form they reduce the effectiveness of the liquor evaporators. Poor heat transfer results and energy is wasted. Once the scale becomes thick enough the mill is left with no choice but to shut the evaporator down and boil it out. In addition to the loss of productivity and long term damage that occurs from the acid boil outs large quantities of very weak liquor are produced all which must then be evaporated with considerable energy consumption. Specialty chemicals are applied to the liquor at the evaporators to prevent of reduce the scale formation. The end result is a lower demand for energy consumption at the evaporators.

SPECIALTY CHEMICAL VERSES COMMODITY CHEMICAL

The term specialty chemical requires a definition as it is often confused with commodity chemicals. For the purpose of this discussion commodity chemicals are products such as caustic, acid, sodium sulfite, lime, alum and other chemicals that are well known, require no technical assistance in their application and are generally purchased on price per kilo basis. Although quality is and issue, the quality specifications are easy to meet. Shipping and logistics are very important as they affect delivery and inventory costs. Specialty chemicals differ in that they are typically blends of chemistry formulated to perform a specific function in a specific environment. Application of these products requires proprietary knowledge and the added value associated,with their application is a part of their costs. Generally considerable knowledge of process as well as formulation selection are required prior to any application attempts. Trial runs of the application are required to measure performance and determine economic benefits. On going services are all so required to insure that the applications continue to perform and that continuos improvement efforts are maintained. The application of specialty chemicals requires that a mutual beneficial working arrangement be developed.

OPPORTUNITIES

FROM THE WOOD YARD TO THE REEL

Forward: Not all application presented here in are practiced globally, some of the application are regionally or climate specific.

WOOD YARD ENERGY SAVINGS:

In colder especially severely cold climates wood chips will freeze together when shipped in open rail cars. The only way to unload the cars is to place them inside a building and then use steam to thaw the chips out so that they can be unloaded. Application of a specialty chemicals at the wood yard prevent the chips from freezing together thus eliminating the need for steam and reducing energy consumption in the wood yard. It may be noted that similar technology is used for shipping coal in the wintertime in cold northern climates.

LIME KILN ENERGY SAVINGS

A major consumer of energy in the Kraft liquor recover process is the lime kiln which regenerates the lime mud recovered from the white liquor clarifiers. The lime mud is washed usually on a lime mud filter of some arrangement. Often these are drum type wahsers but centrifuge arrangements have also been used. The resulting washed mud is then processed thorough the kiln. The lower the moisture contents after the washing lower the energy demand in the kiln. In addition, the cleaner the lime mud, lower soda content, the fewer the number of ball and ring problems that occur within the kiln. Specialty formulations are added at the lime mud washers, not only do they produce cleaner mud they also produce a dryer lime mud. Reductions in gas consumption going into the kiln and energy savings are how these programs are justified. It must be noted at this point that failure to effectively clarify the green liquor and white liquor prior to the mud washing process will result in poor results at the mud washers. Dregs carry over from the green liquor will greatly reduce the

positive affects of effective mud washing. Specialty chemicals are often used to improve the operations of the green and white liquor clarifiers.

STONE GROUND WOOD ENERGY SAVINGS:

Ground wood operations typically involve stone type grinders that are known to plug with wood pitch type deposits. When the stones become coated they loose their effectiveness thus wasting valuable energy and producing a poor quality product. Specialty chemicals are added to keep these stones clean and operating at top efficiencies.

RECYCLE FIBER OPERATIONS:

Various grades of recycled fiber are used to make almost all grades of paper. The repulping, screening and cleaning of this fiber steams requires relatively high levels of energy especially the repulping stage. In addition to heat, and commodity chemicals, specialty chemicals are sometimes added to the pulper to improve this pulping operation. Energy savings result from shorter pulping times thus increased through put and reduced energy costs on a per ton basis. Some recycle grades such as wet strength containing papers may require high levels of chemical addition to justify their use

REFINER ENERGY SAVINGS:

Few if any paper stocks are processed without some level of refining. Refiners systems have several things in commmon they all consume large amounts of electrical energy, they wear out expensive refiner plates as if they were free and they make enough noise to drive one crazy. If acceptable to the process, an alkaline additive (Sodium Hydroxide) may be added to the stock prior to refining. The addition of this commodity chemical and refining at an alkaline pH will improve the energy transfer to the stock. This produces improved refining at reduced energy levels and is the only commodity application that I will mention in this presentation.

FORMING PRESSING AND DRYING:

The paper making process is where the highest level of specialty chemicals are typically used. A good rule of thumb is that for every dollar spent on removing one kilogram of water on the table you spend two dollars removing the same kilogram of water in the press section. To remove that same kilogram in the dryers it will then cost four dollars. It is no wonder that papermakers will spend millions to increase the web solids after the press section.

FORMING/PRESSING ENERGY SAVINGS:

Free water needs to be removed from the web via free drainage, foils and vacuum boxed prior to the press sections. The dryer the sheet leaving the coach the better the water removal in the press section. Retention and drainage aids are added to the stock to improve the water removal at this point in the process. A well-formed sheet will press better giving up more water to the felts in the press section. These two actions produce energy savings be producing a dryer sheet out of the press section and thus a lower demand for energy in the dryer section. A well designed retention and drainage program can produce a 10-15% reduction in steam demand in the dryer section. Retention and drainage programs require the application of specialty chemicals. In many cases multiple formulas are added to produce the desired results. State of the are programs may require three or more components.

PRESSING ENERGY SAVINGS:

Press sections require that the felts used to ırry the water away from the web be clean and rous. If the felts are allowed to plug with deposits y will no longer carry the proper amounts of ter and the resulting moisture level in the web l increase. Once again higher moisture out of the press results in higher energy consumption in the press section. Specialty chemicals are used to clean and condition the fabrics so that they work effectively through out their useful life.

DRYER SECTION FABRICS ENERGY SAVINGS

Just as filled and plugged press felts result in increased energy usage, filled and plugged dryer fabrics also result in increased energy consumption. Here again specialty chemicals are used to clean and condition these fabrics.

CONCLUSION

The application of specialty chemicals and their resulting impact on energy consumption are well proven in the paper industry. Be it directly measured energy savings as observed in the lime kiln or in the dryer section or indirect savings that result from efficiency improvements specialty chemical justification should always include and energy consideration.