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Clean technology and its advantages in relation to traditional technologies

SALIM IBRAHIMEFENDIĆ, AMRA TUZOVIĆ, MARIJA GARIĆ, ALDIN OBUĆINA

FACULTY OF TECHNICAL STUDIES, UNIVERSITY OF TRAVNIK, BOSNIA AND HERZEGOVINA

ABSTRACT

The development of consumer society is dependent upon the notion of industry with its ancillary elements such as providing the work area, using earth materials, minerals in water, wood material, waste storage facilities, etc. Waste gasses and small solid particles, as well as integral components necessary for conducting technological processes are emitted into the atmosphere.Humans, that is, the society are at the centre of the entire system, and the mechanism as a whole is established and carried out for their existence. It is precisely due to the increase of the world population that the needs for material products grow, leading to an unimaginable rate of using resources and energy sources. On the other hand, the resulting waste in solid, liquid and gaseous state is increasing, and therefore, it is necessary to provide storage facilities since the atmosphere is being saturated due to its excessive concentration.

Keywords: clean technology, waste materials, storage facilities, impact on health, humans, flora and fauna

Introduction

Haphazard usage of natural resources and the surroundings has had negative impacts upon the environment due to changing and disrupting the eco-balance, and, if this process should continue with the same intensity, it would bring forth a cataclysm on the Earth's surface.
The concern of science and the economy to find the most optimal solutions is continuous, considerable financial resources are allocated for scientific and developmental research alongside informing and motivating the population on the state and significance of ecology, as well as its connection with human lives and their health, or simply put, on preserving life on Earth. Legislation has focused on the content and status of pollutants and the environment, forcing everybody in the chain of polluters to comply with certain standards and behaviours in line with legislation and regulations of European, state and local character.

Clean technology and its advantages in relation to traditional technologies

Clean technology can cause radical changes in production processes resulting from innovation in the levels of production, or specifically, by using secondary products developed in a different way.

Liquid and solid waste is classified in industrial processes that pollute the environment by contaminating the water and air.

Such classification is being continually expanded by areas in accordance with the development of new technologies and processes.
Image 1. provides a schematic overview of preventive and tested measures for controlling industrial emissions.

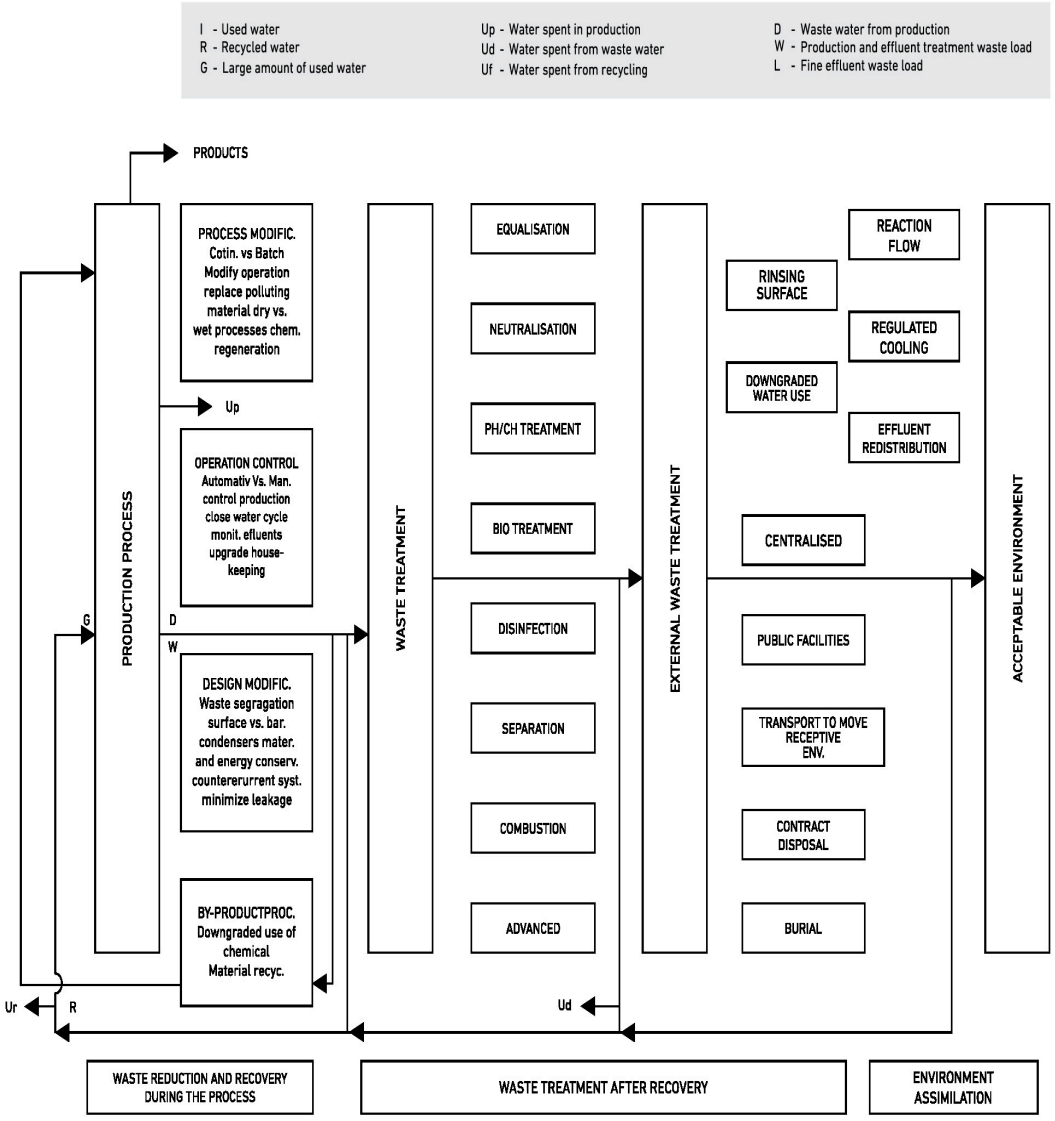

Image 1: A schematic overview - preventive and tested measures for controlling industrial emissions

Image 1. schematically represents different programmes and activities whose realisation depends on the level of development in industrial plants. The development and implementation of pollution control systems is the basis of socioeconomic programmes and improvements in the quality of health, as well as preserving common values of the society and community. The development and implementation of joint programmes with external treatments strengthen the measures which reflects costs. Implementation of long-term programmes requires educating the staff and practice.

The policy and established methods for promoting and developing clean technologies

Clean technology has two primary advantages, namely, the possibility of reducing pollution and eliminating emissions at the same time. Likewise,

it enables greater control of the process and decreases the risk of accidents or hazards. From an economic point of view, clean technology generates energy savings leading to a faster return of investments in raw materials whose deposits are, due to depletion, rather scarce in composition, quality and quantity. Planned strategic preventive measures help in improving productivity which enables competitiveness in business. Such policy reaches most workers and their awareness on the significance of production with new processes resulting in reduced pollution, investments become more efficient and treatment of pollutants is ensured which is an integral part of the production process.

Advantages in several areas are achieved through a clean-technology strategy, and the developmental policy should be lead towards more technological changes that cause growth. There are three levels of the approach, and the first one is founded upon European standards and individual levels of technology. Subsequently, it is necessary to discuss the strategic plan and determine new legal regulations which will be applied. Final discussions should be conducted for innovations in ecology and their application sites which requires corrections of the remaining legal acts.

In the last one, three principles can be applied:
- legal regulations,
- financial effects - practice and
- information.

Legal regulations arose from application, and they consist of several factors classified in relation to the area of application and a potential risk of hazards. Financial effects arise from the financial incentive policy and should be constant. Assistance with this law lies in innovation and introduction of new technologies through developmental research papers on new technologies and projects, with pollution reduction as its basis. Inovation assurance should be provided through financial plans and programmes where special emphasis is placed on teaching and training the management through various courses, lectures at schools and faculties alongside publishing corresponding brochures and instruction manuals.

It is reasonable that the entire process should be of a public character with the desire to familiarise the public and ask for long-term public support.

Internal measures in pulp and paper mills

The internal purification process for controlling pollution in the pulp and paper industry is a normal process which is related to recycling effluents, preferably integrated with the purification process. Internal purification processes are ecologically effective in case of pollutants, melted organic substances and suspended solid substances, as well as if they can be used for the product again or disintegrated.

A decrease in the amount of effluents through recycling represents a measure, and a certain effluent flow concentration affects the improved external purification. The example where an increase in recycling process water decreases the water consumption per tonne of production is most evident in the consumption of fresh water during the process of obtaining bleached Kraft pulp. In this case, the consumption drops from 200 m3/t to 50 m3/t, and has a decreasing tendency. In most cases, the effects of recycling water are evident, the heat and energy consumption is lower, the consumption of chemicals is lower, and the fibre loss is lower, which significantly impacts the price of the final product. The technological process of producing pulp and paper consists of several technological units that can also be separate but, when it comes to energy and raw materials, they build on the resources in the main cycle, or the energy resources and raw materials are relocated to different facilities
For modern bleached pulp mills, answers can be found in the following external measures as standard solutions:
- dry debarking of wood,
- efficient washing and screening the dissolved wood materials from cooking in the separation and chemical recovery system (around 99%),
- intensive recirculation of water from the bleached pulp plant,
- steam stripping of condensates and all seondary condensates,
- monitoring the wood liquor and fibre dispersion, as well as treatment and return in the recovery system
- increasing the capacity of the evaporation plant and the liquor-recovery boiler for occasional collection of dispersed black liquor,
- collection and reuse of clean cooling waters.

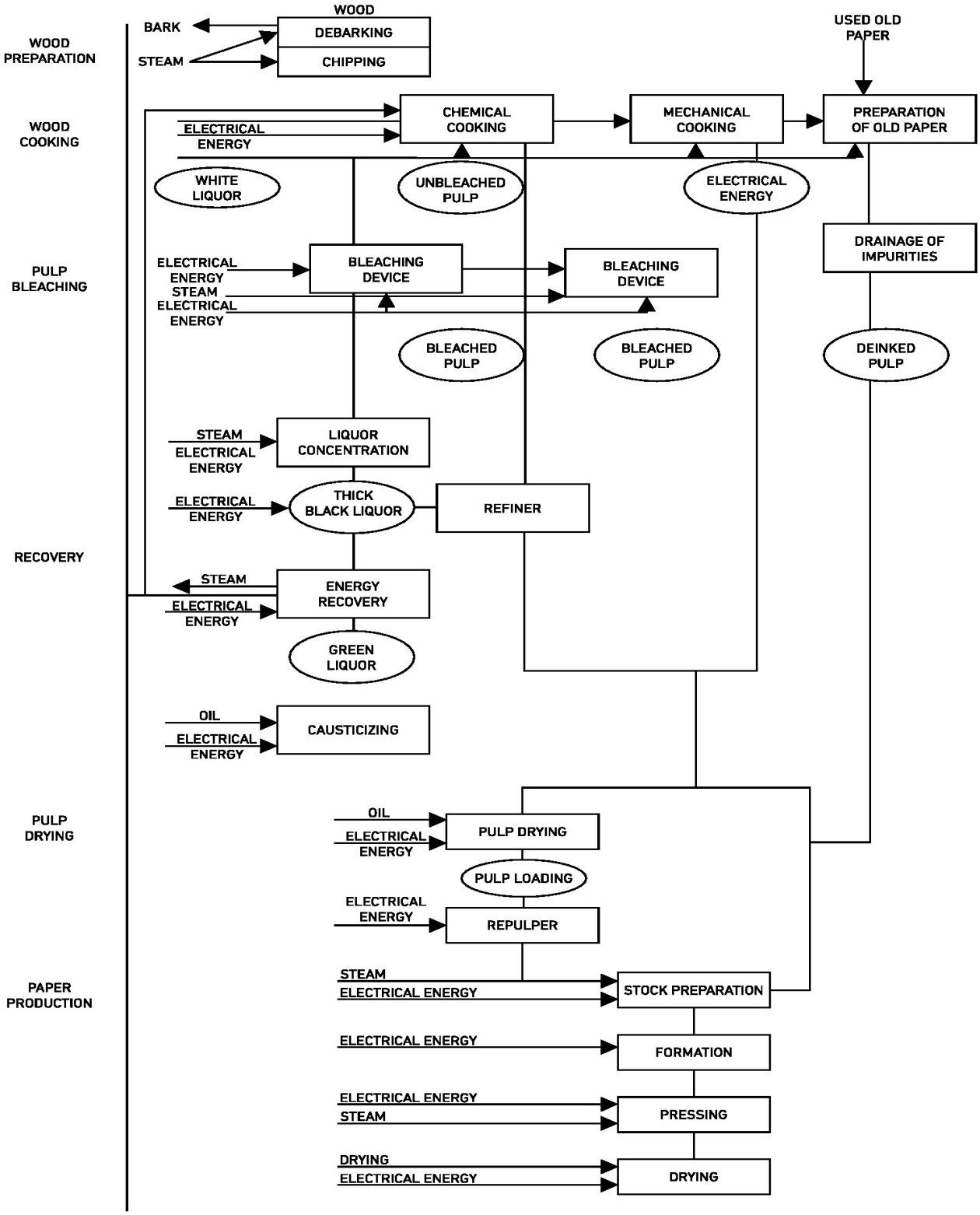

Image 2: The technological pulp and paper production process

The largest problem in a Kraft pulp mill is the waste water from the bleaching process.
The result of contemporary measures for the total kraft process waste load is a decrease of the following values:

- effluent flow rate 35-50 m_3/adt
-
- BOD_5 20 kg/adt
-
- TS_5 10 kg/adt

On the other hand, specific consumption in pulp bleaching is decreased by approximately 25% and the largest part of this reduction is related to improvements in environmental protection measures.

In a modern integrated TMP paper mill, typical measures that have to be undertaken are:

- dry debarking of wood,
- complete dissolution and integration of the TMP white-water system with the paper machine water,
- using white water or secondary condensates from TMP - block heat exchangers from wood chip washing instead of fresh water,
- decreasing the consumption of fresh water in the white process water separation and recycling systems for diluting the stock in the tanks,
- clarification of white water for reuse in areas where clean water is necessary,
- decreasing the consumption of fresh water by recycling white water for areas where fresh water is not necessary,
- drain separation which is constructed for the possibility of using dirty instead of fresh water, or the option of recycling through the cooling tower system,
- a reduction in discharge with breaks and unnecessary fresh water input,
- minimising the number of fresh water consumers for the entire system,
- minimising the number of consumers that require white water cleaning, which is necessary for the systems,
- optimising the dimensions of the broke system,
- monitoring the control of pulp, broke and white water storage volume with the help of storage in tanks and the advantages of integrating a wide range of system control.

By applying these measures, the specific consumption of water in paper mills can be decreased to approximately 10 m3/tonne of paper in typical value BOD5 (Biological Oxygen Demand five day)and TSS (Total Suspending Solid).
The load in modern TMP (Thermomechanical Pulp) mills can be the following:

Table 1.

value	kg/t of paper
BOD_5	**8-15**
TSS	**5-15**

With supplements for a simultaneous effect in raw materials and energy consumption, the system is closed resulting in improved retention of water pollutants on the sieving part of the paper machine.

A large number of results from experiments for BOD load in modern mills with closed white water systems show that it can be up to 50% lesser in relation to older mills.

Image 3. shows the process water cycle with a purifying device, as well as a closed-loop system for using purified waste water.

Using modern retention agents such as polyelectrolytes plays an important role in such instances.

Future development of paper mills

In modern paper mills, the degree of using clean water is lower due to usage of reclaimed water, but not without difficulties. Increased usage of reclaimed water causes a deterioration of quality and operating difficulties.

The concentration of melted organic substances in white water increases with the effect taking place in the wet part of the paper machine and the quality of paper.

In modern mills, pulp bleaching represents a part of the effluent load, defined as colour in effluents, and improvements in the decrease of effluent load are possible, implying the following measures:

- wood preparation through dry, instead of wet debarking,
- washing and separation,
- condensate treatment.

Bleaching with chlorine containing chemicals is a large source of pollution in modern Kraft mills. Its alternatives are:

- extended delignification according to the modified modern cooking technology,
- oxygen bleaching where the delignification can be extended by oxygen bleaching until reaching the kappa numbers 16-18 with softwoods,
- pollution caused by pulp bleaching can be decreased if delignification and oxygen bleaching are applied,
- chlorine replacement with chlorine dioxide is a large substitution of approximately 90%, representing a reduction in toxicity and colour in effluents,
- improving the degree of extraction,
- using peroxide and oxygen in extraction decreases the usage of chlorine containing chemicals where the environmental pollution effect is insignificant,
- recycling filtrates with bleaching filters.

Pulp bleaching represents a large pollutant in pulp mills, and the only way to decrease it is through effluent purification.

Future development of paper mills

In external purification of waste water, dangerous substances arise, and today, they are successfully used as raw materials for other technologies and an energy source.

The bark resulting from the debarking process is used as fuel or compost. The separated sulphur soap from softwoods treated with sulphuric acid and the resulting tall-oil is, through the distillation process, decomposed into several component out of which the abietic acid, $C_{20}H_{30}O_2$ is used in paper production as a binder and in paint and varnish factories.

Turpentine separated from softwoods is, through the distillation process, cleaned and decomposed into several integral components whose usage is necessary in chemical industry, paint and varnish industry and fragrance manufacturing. Another method of purifying waste water is irrigation, i.e. water discharge on shrublands where the melted substances are sedimented to the surface increasing fertility or serving as plant nutrients, and the purified water is discharged in the watercourse.

Image 3. provides a schematic overview of the recycling process for waste water from the fibre production process, alkali regeneration and paper production.

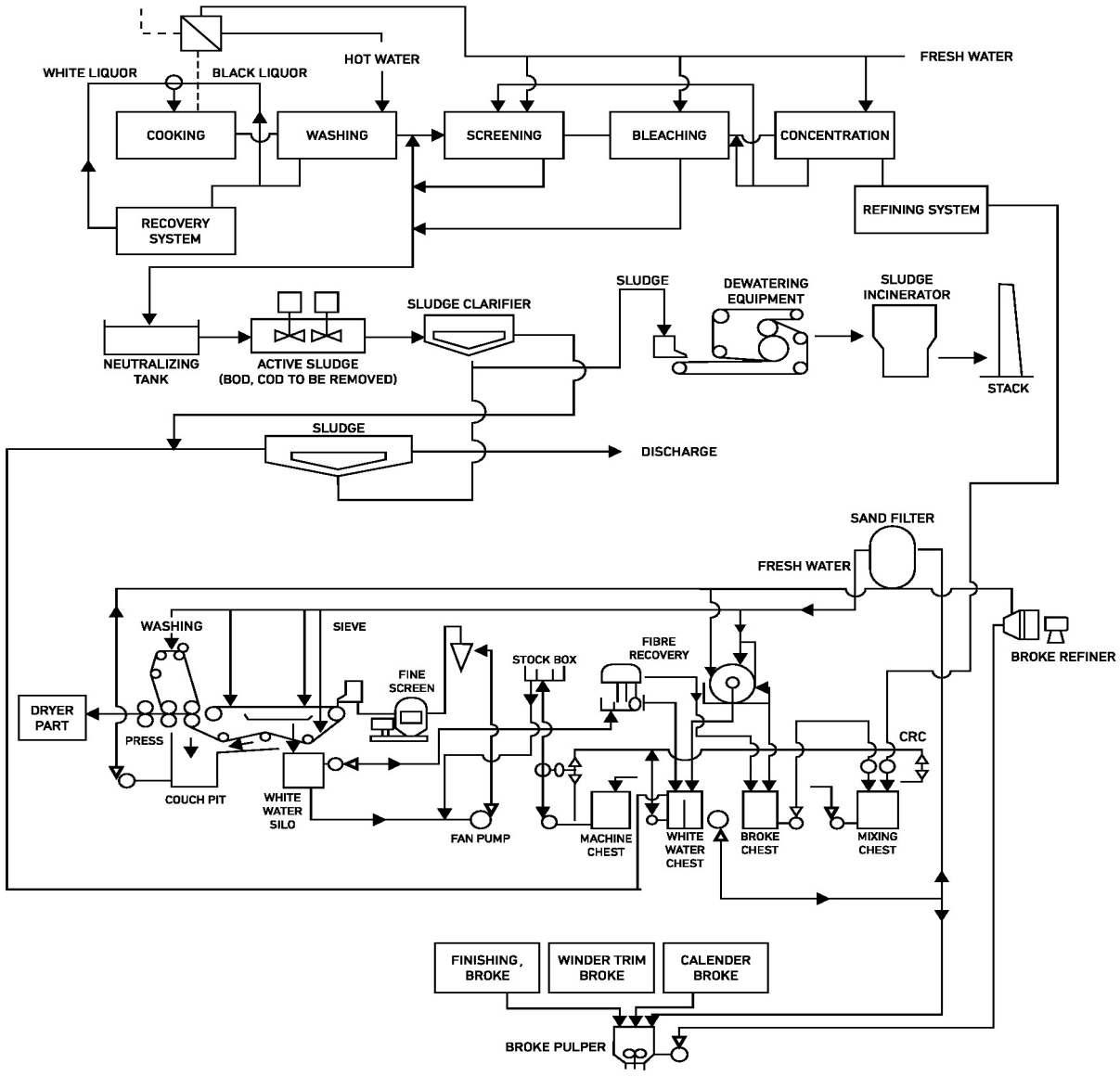

Image 3: Waste water recycling from the fibre production process, alkali regeneration and paper production

Black liquor waste from sulphate and sulphide cooking is separated from the recovery cycle and chemically treated whereby producing: lignosulphonates, Kraft lignin, lignin products, ethanol, wood materials and protein products. Due to its plasticity, lignin has been used for a long time in the production of cardboard boxes. In composition with phenol-formaldehyde resin (PF), a new commercial glue is obtained. When ultrafiltration of black liquor is conducted through fractionation, Pekilo protein (a Finnish patent) is obtained in the technological process of waste water purification.

The process can be conducted without air (anaerobic treatment) while obtaining methane, or with air (aerobic treatment) where the quality of sludge and the composition and content of dry substances is significant. In general, it can be concluded that pulp production form wood raw materials is a cost-effective procedure, and, for a long period of time, the natural fibre will not be substituted with another type of fibre used in mass production of various types of paper and pitch.

Conclusion

The business policy of every company opting for clean technology development programmes is founded on the economic and technological foothold.
From an environmental standpoint, clean technology has two main advantages: it reduces pollution and eliminates the emission of harmful substances.

Likewise, it enables greater control of the process and decreases the risk of accidents or hazards. Clean technology results in energy savings which leads to investments. Waste treatment results in energy and raw material savings that constitute the foundation for a return of investments.

The advantages of clean technology are founded on the following elements and possibilities:

- raw material savings,
- water savings,
- utilisation of waste products,
- energy savings,
- security improvements, reduction of odour and solid matters in waste gases,
- complete elimination of air pollution, and thereby the appearance of acid rain,
- a biotechnological approach in ecology based on waste materials creates a wide spectrum of new products such as composts and the production of proteins and raw materials for other technological processes,
- proteins for animal nutrition, as well as supplements for other marketable products,
- using certain components from liquor regeneration in pulp production following a sulphide and sulphate process creates opportunities for producing a series of products for the construction, chemical and processing industries.

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Čista tehnologija i prednosti u odnosu na klasične tehnologije

SAŽETAK
Razvoj društva sa materijalnim potrebama je uvjetovan pojmom industrije sa pratećim elementima kao što su obezbjeđivanje radnog prostora, korištenja sirovina iz zemlje, minerala vode, drvne mase, prostora za skladištenje otpada i drugo.Atmosfera služi za ispuštanje otpadnih gasova i sitnih čvrstih čestica kao i sastavnih komponenti neophodnih za odvijanje tehnoloških procesa. Središte cijelog sistema je čovjek, odnosno društvo, za čiju egzistenciju se uspostavlja i obavlja cijeli mehanizam. Upravo iz razloga povećanja populacije na zemlji, rastu potrebe za materijalnim proizvodima što dovodi do neslućenih razmjera korištenja resursa i energenata. S druge strane, nastali otpad u krutom, tekućem i gasovitom stanju povećava se te je potrebno obezbijediti prostor za skladištenje jer u dolazi do zasićenosti u atmosferi zbog prekomjerne koncentracije.

Ključne riječi: čista tehnologija, otpadne materije, skladišni prostor, utjecaj na zdravlje, ljude, biljni i životinjski svijet

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Correspondence to: Salim Ibrahimefendić, University of Travnik, Faculty of Technical Studies, Travnik, Bosnia and Herzegovina)
E-mail: marija.fts@gmail.com