MININMUM ENERGY PERFORMANCE STANDARD (MEPS) IN PROCESS OF WOOD PANELS PRODUCTION IN IRAN

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Abstract:

Industry sector is considered one of the important energy consumer sections in our country. Wood panels production industry, however, classified as energy intensive activity. Therefore, conservation the energy and reduction of energy usage is very important in national view of point in this section. After the National's third programme on socio-economic development, the Iranian government has promoted several actions on energy efficiency, including the national regulation for compulsory energy criteria specification in processes of wood panels consists particle board, high density fiber board (HDF), medium density fiber board (MDF), ply wood and lamina wood. This article summarizes the results of a project on energy consumption criteria in wood panel industry processes in Iran. The project's aim was providing energy consumption criteria in theses processes to improve energy use efficiency with respect to their technical, economical and financial situation.

The needed information and data such as yearly production and energy consumption, both electricity and fossil fuels were gathered throughout questionnaires. Some additional information (like energy saving potential and energy saving opportunities) were gathered from short energy audit in some selected factories in each group. Energy consumption criteria were compiled using theses data for present factories and energy consumption information of some developed countries was used for new design production lines. These two criteria were approved by approval committee of energy consumption criteria including ministry of energy, ministry of Oil, Institute of Standards and Industrial research of IRAN and environment Protection Organization delegates in September 2006. Execution of this energy consumption criteria would be accounted a step advancing our country to save our resources and reduction green house gasses and also enable our country to export more energy instead of consuming, gaining more money.

***Keywords**: Specific energy consumption, wood panel processes, energy audit, criteria for energy consumption*

1. Introduction

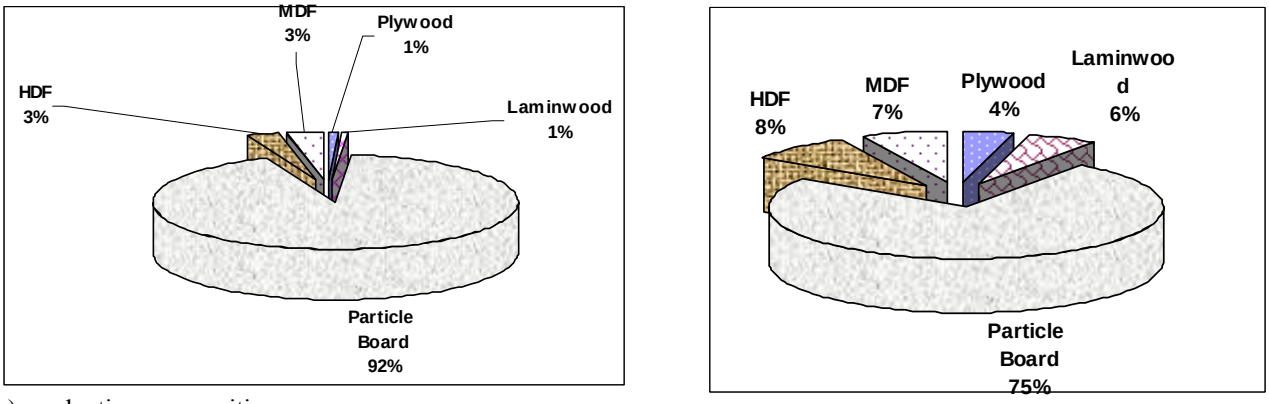
Improving energy efficiency at the end–use level is increasingly important as climate change commitment force policy markers to look for areas where greenhouse gas emissions reduction can be achieved rapidly. Although much improvement has been made over the past years, significant potential for improving energy efficiency, particularly in Iran industry consuming around %20 of the total primary energy, still exist.

Labeling and minimum energy efficiency standard for appliances and processes have proven to be one of the most promising policy instruments. Under for many years in some countries, they delivered tangible results. In our country, the first energy efficiency law was acted in country's third economic, social and cultural development program about one decade ago to establish the National Policy of Conservation and Rational Use of Energy Promoting Efficiency initiatives for home appliances equipments and also industrial processes. In order to reduce energy consumption in wood panel production industries and program of labeling and minimum efficiency standards in mentioned processes, this study was been carried out.

The production share of our country for particle board, HDF, lamina wood and ply wood are 0.33, 0.55, 0.054 and 0.006 percent respectively, in total world's production.

The history of foundation wood panel based production industry came back to about 1955 in north of Iran. There have been established more factories since then. Fig. 1 shows the production composition and energy consumption, both electrical and thermal, percentage. As it is shown in figure 1-a, particle board is the largest production group among wood panel

production family. High Density Fiber Board (HDF) is in second place and ply wood and lamina wood production is the smallest production group. The main reason for that, lack of raw material resources (forest) in our country, import limitation and coming the none-wood based production such as PVC, Melamine, Formica and so on.
Actually, the wood panel production industry, except MDF, is aged and old fashioned; Moreover there are not enough qualified wood resources and energy supplied to consumers in subsidy, cheaper than actual prices. With this overview of this industry, we should expect to face with an industry with higher energy intensive compare to developed countries wood panel processes industry simply due to mentioned technological and availability wood resources differences. In this paper we describe the energy criteria specification task for wood processes in Iran aimed to persuade this industry to efficient use of energy. The principle of this work is described in the following.



a) production composition

b) Percentage of consumed energy

Figure 1: Composition and energy consumption of wood panel production in Iran in percentage.

2. Wood Panal Production Processes

The major wood panal processes industry in Iran are: Fiber board, Particale board, Ply wood and Lamin wood production industry. In the following, we describe these productin's processes briefly.

2.1. The production of ply wood

Ply wood is a wood based panel that consists multiple layers veneer. To produce veneer sheet, logs are rotated around their length against a knife which peels thin layers of wood from the log. The veneers are then dried and glued together in such a way that its grain direction is at right angles to that of the adjacent layer. The last step is hot pressing of the panels. Prior to hot pressing many mills pre-press assembled panels with a cold press.
With respect to lack of raw material in our country and existing some limitation to import logs and also improt of large amount ply wood and lamin wood from oher countris, the most factories of this products were closed. It is forecasted, there will be established no any new ply wood and lamin wood industry units, therefore, these processes are omitted from our work scope.

2.2. The production of particle board

The Particle board industry is the largest industry in the country compared to the other industries producing wood based panels. Particle board consists of small wood parts that are glued together under high pressure. Most of the raw material is low quality wood that is not used by other wood processing industries, like chipped thinning and sawmills waste. Also clean demolition wood is used in the production process. All the wood is chipped and dried. The wood chips are mixed whit glue and pressed between two hot plates. After pressing, the panels are sawn and sanded. Both electricity and oil is used in the process.

2.3. The production of Medium Density Fiberboard (MDF)

The furnish used to manufacture MDF consists of green or dry wood residues. Fibers and fiber bundles are generated by first steam- heating the wood, then passing in through a refiner. During this step the wood changed both chemically and physically; becoming less susceptible to the influences of moisture and less brittles as the lignin in the wood softens. The semi-plastic wood is then "rubbed" apart in to fibers and fiber bundles in a refiner instead of being mechanically "broken" apart. The blending process for MDF through a value known as the blow value in to the blow line, a larger continuous chamber where the Urea–Formaldehyde (UF) resins is mixed with the wood fiber.

In the blow line, the fibers are sprayed with resin, which is injected from a line located either immediately after the blow value or anywhere along the blow line. Material is dried to acceptable moisture content in a flash tube dryer at low temperatures after the blow line. The boards are then cooled and finished after drying like other reconstituted wood panels. The demand for MDF has been increasing and supposes to be built more units to match that demand.

2.4. The Production of High Density Fiberboard (HDF)

HDF is a higher–density version of MDF. The raw material used to manufacture HDF is same as MDF. Here, in contrary to MDF, process is wet. The fibers are all the same size; therefore, they need no screening. Here, the furnish is not dried, because the forming process uses water. The process mats are formed using a wet process in which fibers are mixed with water and phenol form aldehyde adhesive and then metered on to a wire screen. Water is drained away with the aid of suction applied to the underside of the wire. The fiber mat, along with the supporting wires is moved to a pre-press where excess water is squeezed out. Then it is dried. As with MDF, the hardboard mats are discharged through a blow valve into a blow line after refining. All reconstituted wood panels are hot pressed to increase their density and to cure the resin.

3. Methodology

The first step to specify an energy criterion, knowing the major active manufactures in mentioned processes. In this way, we provided the all major industry units characteristics including company name, foundation year, nominal capacity, actual production from Ministry of Industries and Mines. At the time of doing this project, seventeen, two and one major industries were active in particle board, HDF and MDF manufacturing. The specification of wood panel production is given in Table 1. However, this situation may be changed at present.

After determination of major factories, it was designed a questionnaires to gathering information such as, namely and actual production amounts, energy carriers consumption, composition of production(s), process flow diagram, process machines specifications, energy management activities in factory and so on during past three years. The questionnaires were mailed to all mentioned units.

Indeed, based on information, which collected throughout questionnaires, we specified the energy consumption values of them, and in fact we found out situation of wood panel industry energy consumption patterns. The index of energy consumption was considered Specific Energy Consumption (SEC). According to received information from factories, we calculated their SECs. However, the criteria for mentioned processes would be provided according to energy saving potential that determined by energy audits in some selected units in each process.

4 Energy consumption pattern in units

As it was written, by utilizing the data, gathered throughout questionnaires, we could calculate SEC of each process. Total SEC is calculated using below equation.

$$E_l = SEC_{th} + 3.6SEC_{ELC} \quad (1)$$

Which:

E_t: Total SEC, GJ/unit of product

SEC_{th}: SEC of consumed fossil fuel, GJ/unit of product

SEC_{El}: SEC of cosumed electricity, MWh/unit of product

3.6 is a coefficient to conversation electrical energy in MWh to energy in GJ. Heat value of gas oil, fuel oil and natural gas which used in these industry, were considered 38682 kJ/Lit, 41020 kJ/Lit and 34704 kJ/m^3 respectively.

Table1: Composition of wood panel products in Iran in 2003.

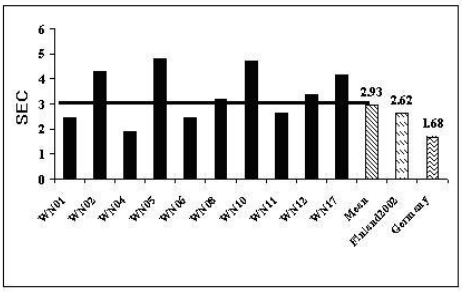
Product	Nember of active units	Nominal capacity (cubic meter)	Actual Producation (cubic meter)	Ratio of actual to nominal product
Particle board	17	705900	655174	0.94
HDF	2	24150	1980	0.84
MDF	1	20000	24610	more than nominal capacity

Source: Ministry of Indusries and Mines

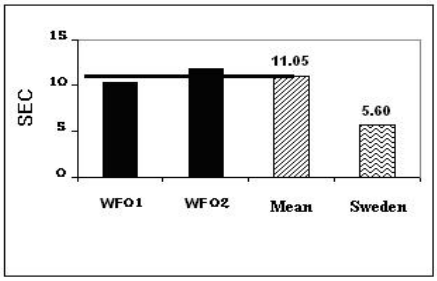
The calculated SECs are given in Figure 2 for a) particle board and b) high density fiber board processes in different units of Iran. As it is seen, the values differ from 1.91 GJ/m^3 for unit coded in WN04 to5.23 GJ/m^3 for WN05 among particle board units. The variation is due to some operation, management and specification factors. The used technologies are nearly same. Also average number for SEC in this process is about 2.93 GJ/m^3. Furthermore, samples of SECs are given from developed countries, which clear the differences with ours.

The similar to particle board, values of SECs are shown and compared to each other and also with a sample in Sweden in this Figure; It is about twice of Sweden one.

As at time of running project, there was just one factory, which was producing MDF, So there is not given any comparison like before. Its SEC equals to 7.73 GJ/m^3.



a) Particlr Board



b) High Density Fiber Board

Figure 2. Comparasion of SECs of different factories for (a)particle board and (b) high density fiber board

5. Energy Audit in selected processes

In order to examine the received information from questionnaire and also identify energy saving opportunities in practice, two energy audit surveys were performed in each of mentioned processes. The result of our observations and measuring activities clears existing considerable energy conservation opportunity to performing, which leads the less energy consuming in these processes. The summary of this potentially saving opportunity is demonstrated in Table 2 to 4. In these tables the energy saving of main sections of processes, both electricity and thermal are given. Due to MDF factory was new-built, this unit was not audited.

Table 2: Thermal Energy saving potentional in main sections of HDF processes, in percent

	Boiler	Pipe network	Defibrator	Press	furnace	Laminat Press	Flue gas	Reduction of exeess Air	Total
Energy Saving Potentional, %	0.257	0.42	16	-	-	1.44	15.29	2.44	45.7

Table 3: Thermal Energy Saving potentional in main section of particle board proccesses, in percent

	Oil Furnace	Pipe Network	Press	Dryer	Boiler				Dryer		Total
					Flue gas		Reduction of excess air		Flue gas		
Energy saving potentional %	0.06	0.52	-	-	Burner capacity				Natural gas+dust	Natrual Gas	47.82
					High	Low	High	Low			
					14.24	6.69	0	10	24	20	

Table 4: Electricity saving potentional in main sections of HDF& particle board processes, in percent

	Boiler	Air compressor	Lighting system	Dryer	Total
HDF	0.8-1	1	3	-	4.8
Partical board	1	0.6	3	-	4.8

6. Providing energy consumption criteria

Actually providing energy consumption criteria is a very difficult and challenging task; because, either it may cause enormous problems for industry units to satisfy it or not consequences to achieve efficient energy use in those processes. In this work, energy consumption criteria for wood panel processes are done based on energy consumption patterns in present factories while considering just low cost energy saving opportunists. In this way, energy reduction amount to achieving criteria would be 9, 12.6 and 7.8 percent for particle board, hard density fiber board and medium density fiber board respectively after three years. The values are given in Table 5. However, for those a built recently and have to give a permission, the criteria is more hard and it given in Table 6.

Table 5: Energy consumption criteria for present wood panel product processes.

Product	**Energy consumption criteria (GJ/m^3), E_t**		
	2007	**2008**	**2009**
Particle board	$E_t \le 2.84$	$E_t \le 2.75$	$E_t \le 2.67$
Hard density fiber board	$E_t \le 10.5$	$E_t \le 10.04$	$E_t \le 9.66$
Medium density fiber board	$E_t \le 7.18$	$E_t \le 6.99$	$E_t \le 6.8$

Table 6: Energy consumption criteria for new-built wood panel product processes.

Product	**Energy consumption criteria (GJ/m^3), E_t**
Particle board	$E_t \le 2.15$
Hard density diber board	$E_t \le 5.6$
Medium density fiber board	$E_t \le 6.42$

7. Benefit of criteria implantation

In respect to energy carrier prices in the view points of consumers and suppliers of energy in Iran, and energy saving amount due to execution of these standard, we can save 350864 GJ equals to 10 million cubic meters natural gas and 29253 MWh electrical energy after three years. The benefit, corresponding to saved energy, is given in Table 7, while Table 8 presents the energy prices assumptions. Total benefit in view of supplier is 2.960 billion Rials, which is equals to 2.96 million US$, considering 1 US$= 10000 Rials for currency rate.

Table 7: Benefit of implenation criteria

Product	energy supplier view of point (10^6 RLS)	energy consumer view of point (10^6 RLS)
Particle Board	2.8E+4	5.94E+3
Hard Density Fiber Board	4.83E+3	1.26E+3
Medium Density Fiber Board	1.99E+3	5.20E+2
Total	**2.96E+4**	**7.72E+3**

Table 8: Assumed energy prices

Energy carrier	energy supplier view of point (Rls)	energy consumer view of point (Rls)
Natural Gas, Rls/m^3	700	185
Electricity, Rls/kWh	770	200

Sources: Iran Economist Journal, August 2008.

8. Conclusion

The goal of this paper is to demonstrate energy consumption criteria provided for wood panel processes in a country, where energy is supplied subsidy, in a low price comparing to the prices of energy in the world. The established criteria are not based on the recent most modern processes for present factories, which is unavailable due to some technological problem. It is based on their energy consumption patterns considering achievable energy saving potential in this industry. By Implementing this criteria, beside to saving really considerable amount of energy, we could reduce more CO_2 emission consequently.

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İRANDA TAXTADAN HAZIRLANMIŞ PANELLƏRİN İSTEHSAL PROSESİNDƏ MİNİMAL ENERJİNİN İSTEHLAK EDİLMƏSİ STANDARTININ YERİNƏ YETİRİLMƏSİ

RİZA ƏFFƏTNİDCƏD, NƏSİR MƏHDAVİ TABATABAİ

İranda taxtadan panellərin sənaye istehsalında, enerjinin dünya qiymətlərindən aşağı olduğunu nəzərə alaraq, enerji sərfiyyatının meyarına dair göstərişlər verilmişdir. Verilmiş göstərişlər bu sahədə enerjiqənaəti potensialına əsaslanmışdır. Verilmiş göstərişlər eyni zamanda atmosferə CO_2 qazının emisiyasının azalmasını təmin edir.

ВЫПОЛНЕНИЕ СТАНДАРТА ПОТРЕБЛЕНИЯ МИНИМУМА ЭНЕРГИИ В ПРОЦЕССЕ ПРОИЗВОДСТВА ДЕРЕВЯННЫХ ПАНЕЛЕЙ В ИРАНЕ

РЕЗА ЭФФАТНЕДЖАД, НАСЕР МАХДАВИ ТАБАТАБАИ

Приводятся данные о критериях потребления энергии при промышленном производстве деревянных панелей в Иране в условиях относительно низкой цены на энергию по сравнению с мировыми ценами. Установленные критерии основаны на энергосберегающий потенциал в этой отрасли. Применение указанных критериев способствует также уменьшению эмиссии CO_2 в атмосферу.