International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization on TPE (IOTPE)

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

March 2010 | Issue 2 | Volume 2 | Number 1 | Pages 15-23

ENERGY CRITERION FOR VEGETABLE OIL INDUSTRY IN IRAN

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Abstract- This paper studies the development of specific energy consumption in vegetable oil industry in Iran. The presented issues include the industry of oil production, production processes and main energy consuming equipments and effective factors on consumption, data collected in relation with annual rate of the products of industrial units and consumption of energy carriers (including electricity, natural gas, fuel oil and petroleum). Based on the type of the production process, the production units of vegetable oils are divided into 4 homogenous groups. The Specific Electrical Energy Consumption (SECe) and Specific Thermal Energy Consumption (SECt) of industrial units are calculated. Furthermore, the results of energy auditing and experience on energy management in vegetable oil industry are mentioned. SECe and SECt for existing production units and newly established production units in vegetable oil industry for Iran are also mentioned.

Keywords: Specific Energy Consumption (SEC), Specific Thermal Energy Consumption (SEC), Vegetable Oil, Energy Consumption.

I. INTRODUCTION

The industry of vegetable oil industry includes industrial activities which lead to the production of types of vegetable oil from vegetable sources (non-animal sources) and also some by-products. According to the definitions of International Standard Industrial Classifications (ISIC), all industrial activities related to the production of vegetable and animal oil (manufacture of vegetable and animal oils and fats) are located at the Class 1514. At present, the rate of annual production of food oil in the world is more than 100 million tons per year. This production is increasing in a considerable growth rate such that the rate of its production growth is about 4 percent. In Figure 1, the world statistic of the production of food oils is presented [1].

At present, the rate of annual production of vegetable oil in Iran (23 production units) is near 1100000 tons per year (equal to 1.1 percent of world production). During a year for each Iranian citizen, in average about 18 liters vegetable oil is produced. The food oils in a general classification are divided into two types of vegetable oils and animal fats. Soya, oil turnip, sun-flower and palm (data) are used mainly in the whole world as the primary materials of vegetable oil. For example, sunflower which is grown in Australia, east of Europe and USA contains 40 to 45 percent oil.

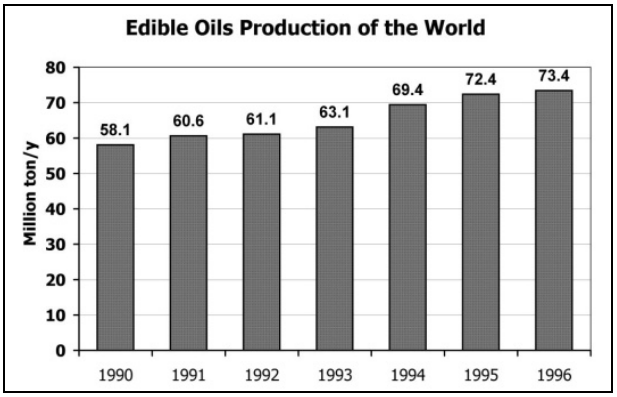

Figure 1. The trend of the growth of food oil production in the world [1]

The process of refinement of vegetable oils begins from crude vegetable oil and continues up to final product i.e. refined vegetable oil. The oil seeds contain a high rate of Linoleum acid and Oleic acid. With the exception of cases in which part of vegetable oil is extracted in form of expression, in other cases, the extraction of oils is done from seeds up to 20 percent or less directly by Hexane in extraction form. When there are higher rates of oil in seeds, in generally the process of pressing is used and then through pre-press and pressing with solvent, the extraction method is used. The resulting oils from these methods contain a high rate of gross materials and can not be used as food oils. For this purpose, it is necessary to remove the various impurities such as free fat acids, color materials, wax and components of colza in the process of refinement. In Figure 2, the process of producing oil from the stage of oil grains up to oil refinement is seen.

Based on the type of the production process (whose full description is beyond the scope of this paper), the production units of vegetable oils were divided into 4 homogenous groups. The four-fold grouping of industrial units of vegetable oils has been determined as follows:

Group 1- Units of refining crude oil
Group 2- Units of refining crude oil and oil extraction (chemical)
Group 3- Oil extraction units (chemical and physical)
Group 4- Physical oil extraction units

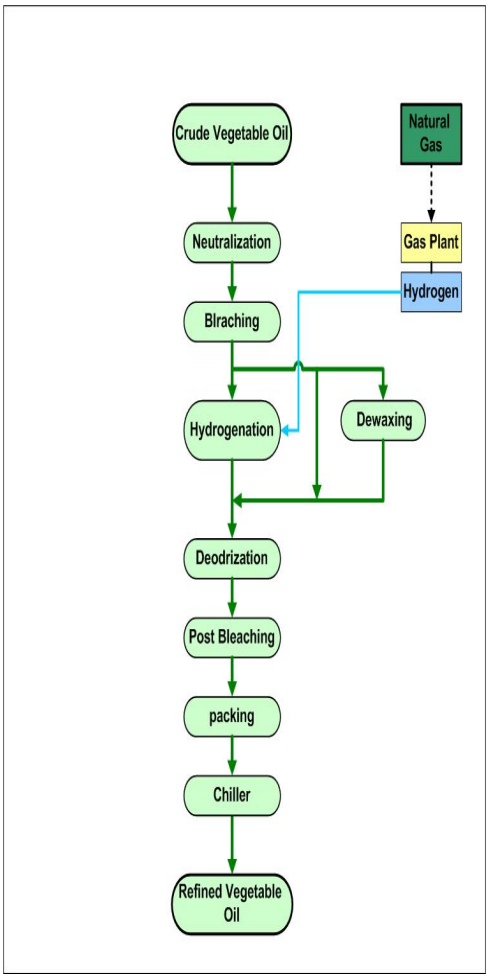

Figure 2. Process of vegetable oil production [2]

II. METHODOLOGY

A. Data

Total energy final consumption in Iran is equal to 779.5 million barrel of crude oil (or 4770 billion mega joule) (in 2004). The industry section in total consumes 156.1 million barrel of crude oil (or 955 billion mega joule) electrical energy, natural gas and types of fossil fuels which form 20 percent of total final energy consumption in the Iran. The share of natural gas, oil products and electrical energy in the consumption of industry sector are 47.4, 37.3 and 15.3 percent respectively. In total, 9.35 percent of the consumption of types of fossil fuels (including natural gas, gas oil, fuel oil and petroleum) of the industry sector has been spent on the industrial group of food materials.

The share of the sub-group of vegetable oils industries of the total consumption of food materials group for natural gas, gas oil, petroleum and total products are 36.0, 12.9, 4.5 and 14.4 percent, respectively. In other words, the greatest consumer of natural gas in the group of food industries is in the sub-group of vegetable oil. Of the total 10.48 million giga joule energy consumed annually in the industry of vegetable oil, 93.5 percent of it, equal to 9/79 million giga joule (or 263 million cubic meter equal to natural gas) has been related to the thermal energy obtained from the types of fossil fuels and the rest of its 6.5 percent, equal to 0.68 million giga joule (or 1899544 billion kilowatt hour) has been related to electrical energy. The share of natural gas in the sub-group of the vegetable oil industry has been higher as compared with other fossil fuels. It is such that 69.8 percent of consuming energy of the types of fossil fuels consumed in vegetable oil industries is related to natural gas.

This share is for gas oil, fuel oil and petroleum is 9.1, 21.1 and 0.01 percent respectively. Comparing the thermal specific energy consumption or SECt which is obtained of the rate of annual energy consumption on annual production, it becomes clear that in Iran in average 224 cubic meter of equal natural gas is spent to produce per ton of vegetable oils. This figure which is the index of output of energy in production units shows that the energy spend for the production of vegetable oil in Iran is two time of that rate in countries with developed economies such as Japan. In Japan, the consumption of thermal energy in vegetable oil industry is about 100 meter cubic meter of natural gas per ton of product [3, 4].

A.1. Energy Flow in the Industries of Vegetable Oil and Detachment of Energy Carriers

With regard to the process of energy in the industry of vegetable oil industry, and in addition to questionnaire data, it is necessary to know the process of energy consumption in different sectors and conduct energy auditing in practice in some different process. The period of measuring in the selected factories is one week and different sample taking was done from different parts by using the measuring sets of electricity and heating. As a sample, one case of it was explained and in total, energy auditing was performed for 4 factories.

A.2. Energy Auditing and Detachment of Energy Consumption in Behshahr Industrial Company

Behshahr industrial company with 1000 tons capacity is the largest production unit of vegetable oil in the country. Reviewing this company was done based on homogenous classification and is placed in the previous sections in group one (refining units of crude oil). That is to say this group has only oil refining unit and is in lack of oil extracting sector.

The data obtained from the questionnaire of this industrial unit in 36 months (2002, 2003 and 2004) indicate that this unit in average produces each month 3408 tons of liquid oil, 18950 tons of solid oil and in total the total production of vegetable oil in average was 222358 tons per month. Based on this, the consumption of specific electrical and thermal energy in this unit was 16.2 kilo watt hours per ton and 208.4 cubic meter equal of natural gas per ton. At the same time, according to the questionnaires of the Group 1, the average of electrical and thermal energy consumption in this Group is 235.9 kilo watt per ton and 185.7 cubic meter equal of natural gas per ton respectively. It is worth mentioning that Behshahr Industrial Company with an average production of 22358 tons per month as compared with 47250 tons of monthly average production of the Group 1 (about half of the total production) has an important role in developing

in this Group. The operations of measuring the consumptions and auditing of energy was performed in the following units [5, 6]:

1. Neutralization or alkaline refinement
2. Bleaching
3. Dew axing
4. Hydrogenation
5. Deodorization
6. Post-bleaching

The results of the detachment of energy carriers by gas and electricity are presented in the continuation of the article. It is worth mentioning that in this factory, the produced vapor in boilers of water tube enter the turbine of Combine Heat and Power (CHP) and used to produce electricity. After the fall of temperature and steam pressure, this steam along with the produced steam of fire-tube is directed into different sectors of the factory. The CHP has an important role in reducing demands of the factory from the city electricity. In other units in which energy auditing was done, there was no such a system (Figures 3 and 4).

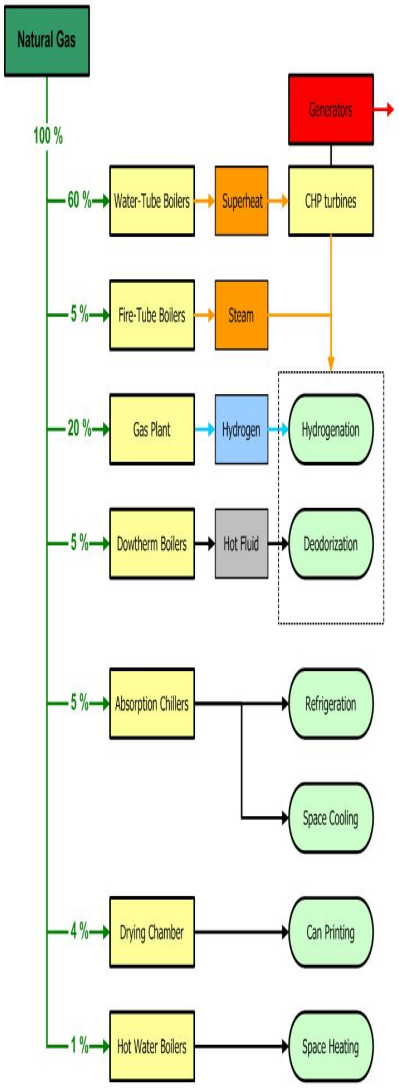

Figure 3. Main consumption of natural gas in Behshahr Industrial Company [5, 6]

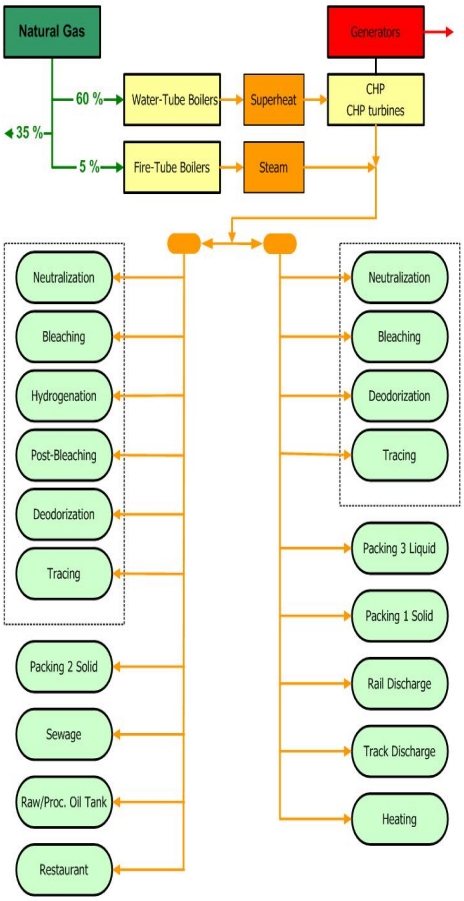

Figure 4. Network of production and distribution of steam in Behshahr Industrial Company [5, 6]

Consumption of electrical energy of the main units of Behshahr is presented in Table 1 and Figure 5. Energy auditing was conduced with regard to the type of the process in 4 other factories whose product by consumption is presented in the Figure 6 [5, 7, 8 and 9].

Table 1. Consumption of Electrical Energy of the Main Units of Behshahr [5, 6, 7]

Item	Description	Share of Consumption (%)
1	Oil Refinning	41.89
2	Packing	21.35
3	PET	10.04
4	Sewage	8.33
5	Gas plant	6.74
6	Water treatment	5.23
7	Compressed air	4.72
8	Can making	1.70
	Total	100.00

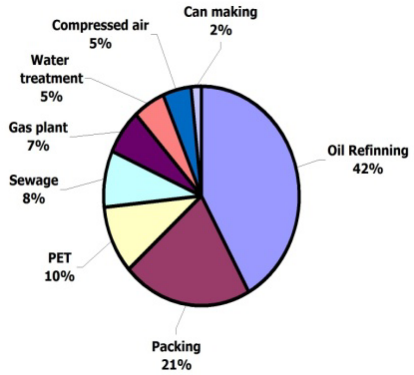

Figure 5. Consumption of electrical energy of the main units of Behshahr [5, 6, 7]

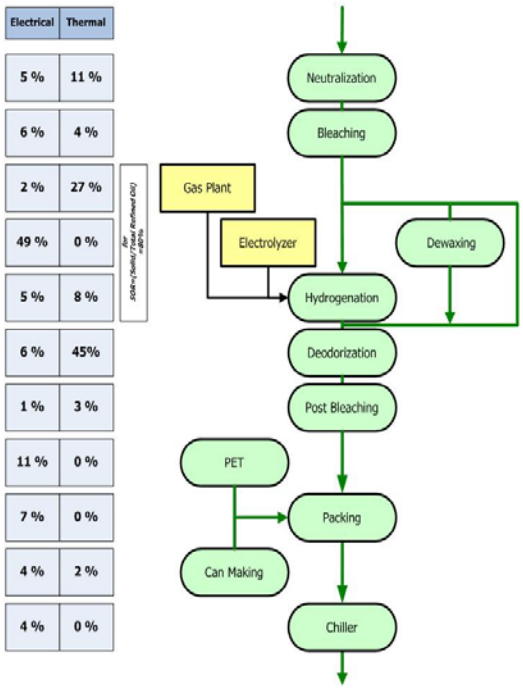

Figure 6. Diagram of detachment of energy carriers in different sections of the process of vegetable oil production in accordance with the results of energy auditing [7]

B. Method

The specific of energy consumption in vegetable oil industries should be developed based on realities and local conditions. So, the statistics collected from the industrial units has a double importance. In order to develop the specific energy consumption in industries, there is a need to collect the related data on the monthly rate of the products of industrial units and the rate of the consumption of types of energy carriers (including electricity, natural gas, fuel oil and kerosene). Also, the data related to the quantities of primary consuming materials, consuming fuel of local power stations, and number of working days and as likes are necessary to analyze the data. Finally, based on the rate of the production of the product of electrical and thermal energy specific consumption is obtained.

The specific electrical energy consumption is the rate of electrical energy consumption of the process to the rate of the production of the product in the same process. The specific thermal energy consumption is the rate of thermal energy consumption of the process to the rate of the production of product in the same process. The four fold grouping of the industrial units of vegetable oil were determined as follows:

Group 1: Crude oil refining units
Group 2: Crude oil refining and oil extraction units (chemical)
Group 3: Oil extraction units (chemical and physical)
Group 4: Physical oil extraction units

In each grouping, the rate of specific energy consumption for each of the production units is specified in accordance with their grouping and displayed in special codes. In each one of the groups, the production unit, number of acceptable sample months, production of liquid/semi-liquid and cooling oil in terms of ton, production of solid oil and confectionary solid oil in terms of ton, total production of vegetable oil in terms of ton, SECe for the total production of vegetable oils in terms of kilo watt hour per ton, SECt for the total production of vegetable oil in terms of cubic meter equal to natural gas per ton (m3 eq. /Ton) are calculated.

Totally, 23 production units related to the Groups 1, 2, and 3 gave back the filled in questionnaires which is equal to 90 percent of vegetable oil productions in the country. Of these numbers, 12 questionnaires were related to the factories of crude oil refining, 7 questionnaires were related to oil refining and oil extraction and 4 questionnaires were related to oil extraction factories. The completed questionnaires were studies and revised and the shortages were removed. The Group 4 which includes physical oil extraction units has low energy consumption and administrated in traditional way, so developing specific of energy consumption for them was ignored. Special codes were allocated to the classified groups.

B.1. Method 1- Electrical and Thermal Specific Energy Consumption for Group 1

Quantities of average, deviation, low limit and high limit allowed for quantities of energy specific consumption in Group 1 is presented in Table 2. Almost half of the total production of Group 1 is related to the Unit of Code 101 (22358 Tons of 47250 Tones of total production). Also the least rate of electrical energy consumption is related to this very unit which in accordance with the results of energy auditing is resulting from employing the CHP system and absorptive chillers.

In this Table, the last line is related to the average of parameters. It should be noted that the average of the of energy specific consumption in this Table (the quantities of 235.8 kilo watt hour pr tons and 185.7 cubic meter equal to natural gas per tons) has been obtained as the product of these quantities by the number of unit. Since the production of solid vegetable oils demands hydrogenation and is in need of higher rate of energy consumption, so that in determining the specific energy consumption, the production of liquid and solid vegetable oil should be considered in each of these unit in one way.

Table 2. Quantities of average, deviation, low limit and high limit allowed for quantities of energy specific consumption in Group 1 [5, 10]

Code	Months	Total Liquid (Ton)	Total Solid (Ton)	Total (Ton)	SEC Electric (kWh/Ton)	SEC Thermal (m3 eq/Ton)
101	36	3,408	18,950	22,358	16.2	208.4
102	33	1,870	9,671	11,541	207.5	184.2
103	36	814	4,404	5,218	315.0	114.1
104	36	1,405	1,094	2,499	192.8	99.2
105	36	218	1,256	1,474	442.1	270.4
106	24	52	2,486	2,538	348.1	354.3
107	36	1,275	0	1,275	168.8	25.2
108	11	347	0	347	196.4	229.8
Total	248	9,389	37,861	47,250	1,886.8	1,485.6
Average	31	1174	4733	5906	235.9	185.7
Standard Deviation					130.0	104.5
AVE - 2xSTDEV					-24.2	-23.3
AVE + 2xSTDEV					495.9	394.7

Since Group 1 only include the units of vegetable oil refinement and there is no process of oil extraction in them, so the share to 10 to 15 percent of the consumption of electrical and thermal energy which is related to the processes of oil extractions are not included in these calculations and this share is distributed among other sections proportionally. The quantities of the weight average of quantities of electrical and thermal specific energy consumption for production units of Group 1 has been calculated based on the share of the production of solid vegetable oil production. The quantities of weight average of the quantities of electrical and thermal specific energy consumption for the production units of Group 1 has been calculated based on the share of total production of vegetable oils. The results of the calculations of the average of consumption of electrical and thermal specific energy consumption has been presented in Table 3, in one place based on the share of each of units from the production of liquid and solid vegetable oils .

Table 3. Weight average of electrical and thermal specific energy consumption of production units of Group 1 [5]

Produced Oil	SOR (%)	SEC Electric (kWh/Ton)	SEC Thermal (m3 eq/Ton)
Liquid	0.0	164.3	139.8
Total	80.1	206.0	173.2
Solid	100.0	219.1	181.5

Since the ratio of production of solid vegetable oil to the total vegetable oil in production units is different, so the final index for the electrical energy specific consumption should be within the limit of 164.3 to 219.1 kilo watt hours per ton. In other words, the production of per tons solid vegetable oils is in need of consumption of about 55 kilo watt hour of further electrical energy of liquid vegetable oil. Also, the final index for the thermal energy specific consumption should be in the limits of 139.8 to 181.5 cubic meter equal to natural gas per tons. In other words, the production of per tons of solid vegetable oil demands the consumption of about 40 cubic meter equal of electrical natural gas more than liquid vegetable oil (Figure 7 and Figure 8.). (The increase of electrical specific energy consumption to the share of production of solid vegetable oils production of the total production) [5].

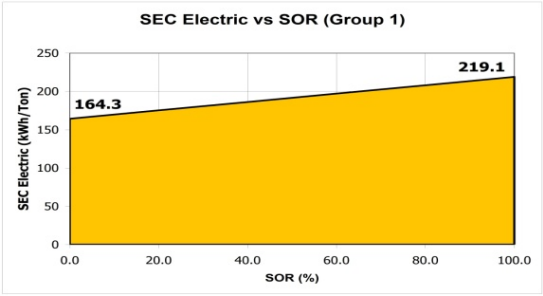

Figure 7. Increase of electrical specific energy consumption in ratio to the share of production of solid vegetable oils of the total production

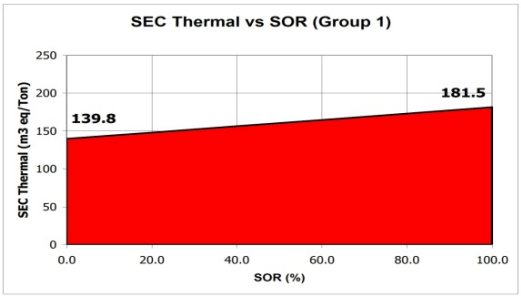

Figure 8. Increase of thermal specific energy consumption in ratio to the share of production of solid vegetable oil of the total production [5]

In order to calculate the impact of the share of gas plant and electrolyze-r on the rate of natural gas and electrical energy consumption in vegetable oil industries, it is necessary that the quantities of the production of solid vegetable oil and rate of natural gas consumption and electrical energy for the production of needed hydrogen per ton solid vegetable oil should be available. On one hand, the average of consumption of hydrogen for the production of per ton crude oil is 65 cubic meter. So we will have [7]:

(**0.36+0.12**) m^3NG/m^3H_2 x (**65**) m^3H_2/Ton = **31.2** m^3NG/Ton

That is to say in order to prepare essential hydrogen in reforming method for the production of solid vegetable oil, 31/2 cubic meter of natural gas is consumed. Finally, in the suggested index, this coefficient has been considered with a little increase of equal to 35 cubic meter of natural gas per solid oil tons and along with the parameter of the impact of the share of gas plant. Also the registered quantities of electrical energy consumption in the unit of gas plant of Behshahr Industrial Company , in average 0.12 kilo watt hours of electrical energy has been

consumed to produce per cubic meter of hydrogen in reforming method. So that we will have [7]:

(**0.12**) kWh/m^3H_2 x (**65**) m^3H_2/Ton = **7.8** kWh/Ton

That is to say that in Behshahr Industrial Company, for the production of hydrogen in need in reforming method, 7.8 kilo watt hour electrical energy is consumed to produce per ton of solid vegetable oils. Finally in the suggested index, this coefficient has been considered with a slight reduction equal to 5 kilo watt hours per ton of solid oil.

Also with regard to the average of the 49 percent share of electrical consumption in Electrolyze-r Unit and also calculations and measures performed during auditing process in the country, with an acceptable confidence, it can be considered that the impact of the share of electrolyze-r in the consumption of electrical energy to be equal to 200 kilo watt hour per ton of solid oil (That is to say that in comparison with 165+55 kilo watt hours per ton oil equal to almost 47.6 percent of it).

Concerning the above-mentioned calculated quantities and also the quantities of specific energy consumption of 8 units being investigated in Group 1, the best option for the specific of electrical energy consumption in Group 1 is as follows:

STDe1 = 165 + SORx55 + SORxGPRx5 + SORxELRx200 [5]

In which the parameter of SOR, is the share of solid oil (between zero to one), parameter of GPR of the share of gas plant (zero or half or one) and parameter of ELR the share of electrolyze-r (zero or half or one). Also the best option for the specific thermal energy consumption of Group 1 is as follows:

In which, the parameter SOR of the share of solid oil is (between zeros to one) and parameter of GPR of the share of gas plant is (zero or half or one) the results have been studies by 8 production units in Group 1 which are presented in Figures 9 and 10.

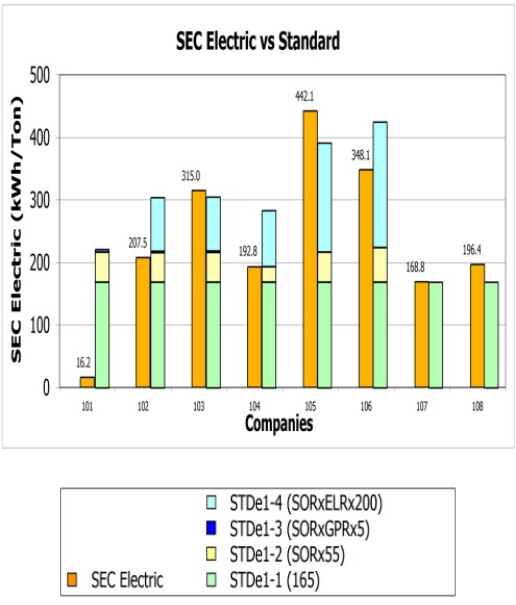

Figure 9. Comparing the Electrical specific Energy Consumption of Production unit of Group 1 [5]

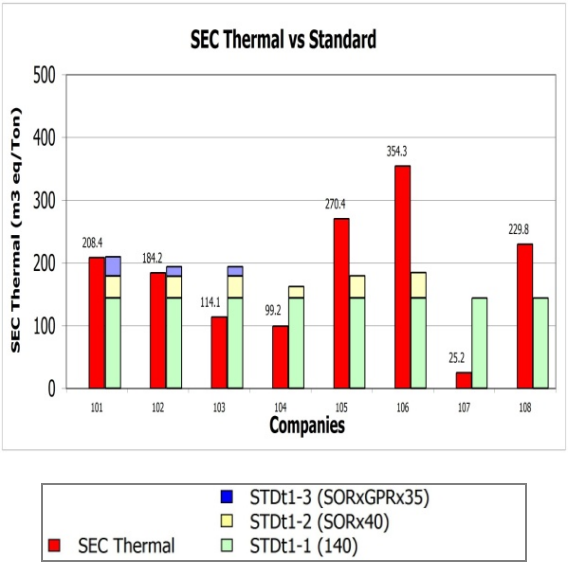

Figure 10. Comparing the electrical specific energy consumption of production units of group 1 [5]

B.2. Method 2- Electrical and Thermal Specific Energy Consumption for Group 2 [5]

With regard to the classifications conducted in different production units of vegetable oils unit, the units of Group 2 both have units of refining and oil extraction. On the other hand, the s developed in Group 1 and Group 3 is related to units in which merely operation of oil refining or oil extraction is done. So concerning the Group 2 in which its units have both operation of oil refining and oil extraction, we can use the s of Group 1 and Group 3. In this case, the of Group 2 will be the total of s of Group 1 and Group 3 by considering the share of extracted crude oil from the oil seeds of the total consuming crude oil in each of the units. With regard to the above explanation, the best potion for electrical energy consumption of Group 2 will be as follows:

STDe2 = STDe1 + CRRxSTDe3

In which the parameter of CRR will be the share of oil extraction (between zero to one) and:

STDe1 = 165 + SORx55 + SORxGPRx5 + SORxELRx200

STDe3 = 260 + OLRx110

and parameter of SOR will be the share of solid oil (between zero to one), parameter of GPR will be the share of gas plant (zero or half or one), parameter of ELR, the share of electrolyze-r (zero or half or one) and parameter of OLR will be the share of oil extraction from the low oil sees (between zero to one) [5]. Also the best option for thermal energy consumption of Group 2 will be as follows:

STDt2 = STDt1 + CRRxSTDt3

In which the parameter of CRR is the share of oil extraction (between zero to one) and:

STDt1 = 140 + SORx40 + SORxGPRx35

STDt3 = 235 + OLRx50

and parameter of SOR is the share of solid oil (between zero to one), parameter GPR is the share of gas plant (zero or half or one) and parameter of OLR is the share of oil extraction from low oil seeds (between zero to one).

For a better comparison of specific energy consumption of units with the quantities of suggested, the results have been studies by five production units in Group 2 which are presented in Figures 11 and 12.

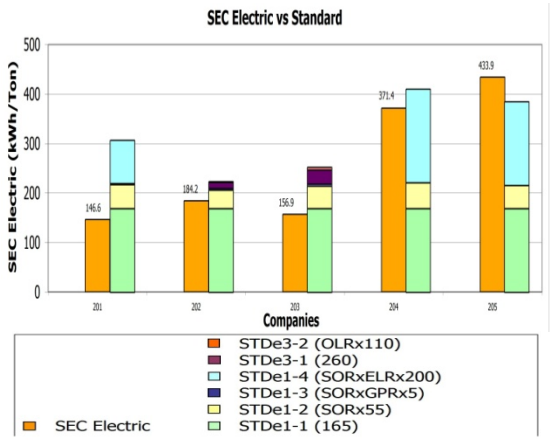

Figure 11. Comparing the consumption of electrical specific energy of production units of Group 2 with the suggested [5]

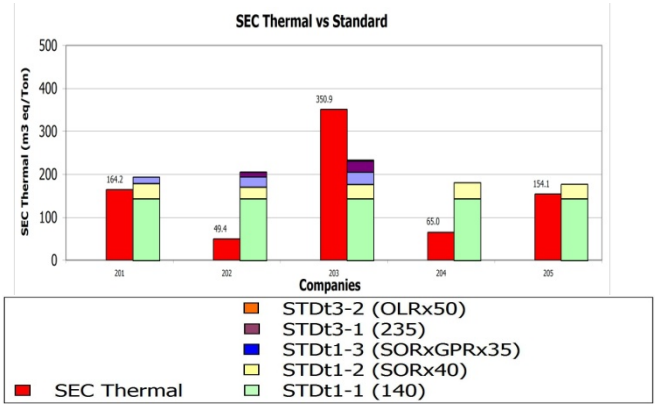

Figure 12. Comparing the consumption of thermal specific energy of production units of group 2 with the suggested [5]

B.3.Method 3- Electrical and Thermal Specific Energy Consumption for Group 3 [5]

Average quantities, deviation and low limit and high limit of the permitted limits for quantities of energy specific consumption in Group 3 is presented in Table 4.

Table 4. Average quantities, deviation and low limit and high limit of the permitted limits for quantities of energy specific consumption in Group 3 [5, 10]

Code	Months	Total Oil-Rich (Ton)	Total Oil-Lean (Ton)	Total (Ton)	SEC Electric (kWh/Ton)	SEC Thermal (m3 eq/Ton)
301	36	812	4,850	5,662	402.2	292.3
302	33	252	347	598	213.6	309.0
303	11	723	378	1,101	114.5	151.9
Total	80	1,786	5,575	7,361	730.3	753.3
Average	27	595	1858	2454	243.4	251.1
Standard Deviation					146.2	86.3
AVE - 2xSTDEV					-48.9	78.5
AVE + 2xSTDEV					535.8	423.7

The quantities of the weight average of quantities of electrical, thermal and total specific energy consumption for production units of Group 3 have been calculated based on the share of production of liquid vegetable oils. In this Table, the weight of each unit has been considered as equal to the monthly production of extracted crude oil from the high oil seeds (sunflower or oil seeds [Colza]) of that unit (The fifth column from the left side). So that the calculated weight average in this Table is in accordance with the share of the production of extracted crude oil from the oil rich sees. The weight average has been calculated by considering the 3 units of average weight. Finally, the quantities of the weight average of electrical, thermal and total specific energy consumption for the Group 3 has been determined as 259.3 kilo watt hour per ton and 237.9 cubic meters equal to natural gas per tons.

The quantities of the weight average of quantities of electrical, thermal and total specific energy consumption for the production units of Group 3 has been calculated based on the share of the production and crude oil being extracted from the oil low seeds. Also in the quantities of the weight average, the quantities of the electrical, thermal and total specific energy consumption for the production units of Group 2 has been calculated based on the share of total production of crude oil extracted from oil rich seeds and oil low seeds.

The results of calculation of the average of electrical, thermal and total specific energy consumption based on the share of each of units from the production of crude oil extracted from the oil rich seeds, oil low seeds and total have been presented wholly. Concerning the above-mentioned calculated quantities and also distribution of quantities of specific energy consumption of 3 units being investigated in Group 3, the best option for the electrical energy consumption in Group 3 is as follows:

STDe3 = 260 + OLRx110

In which the parameter of OLR is the share of oil extraction from the low oil seeds (between zeros to one). Also, the best option for thermal energy consumption of Group 1 is as follows:

STDt3 = 235 + OLRx50

In which the parameter of OLR is the share of oil extraction from the low oil seeds, the results have been studies by three production units in Group 3 which are presented in Figures 13, 14, 15 and 16 [5, 10].

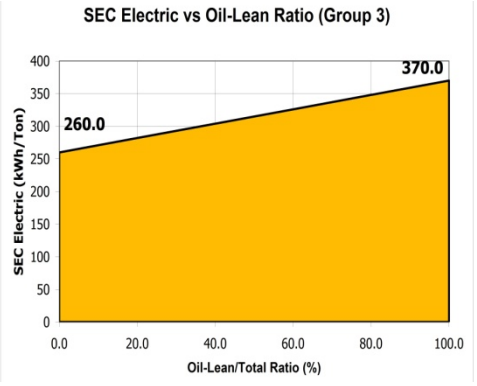

Figure 13. Electrical specific energy to the share of low oil seeds [5]

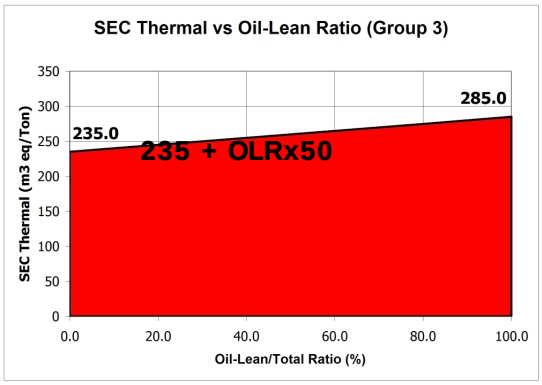

Figure 14. Electrical specific energy consumption to the share of low oil seeds

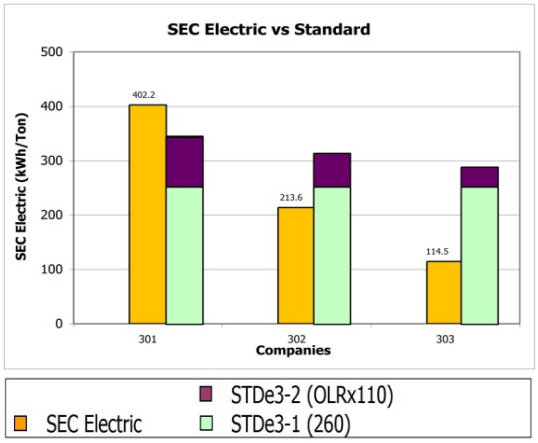

Figure 15. Electrical specific energy consumption in Group 3 based on the share of low oil seeds [5]

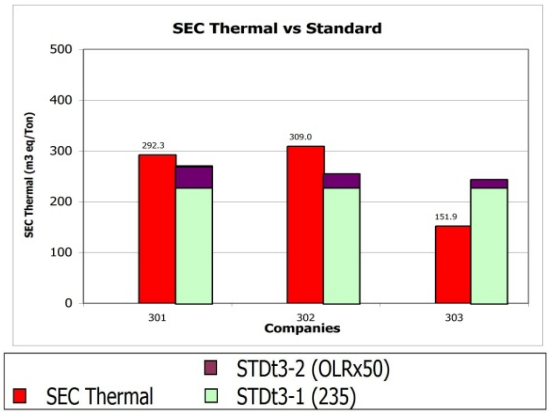

Figure 16. Thermal specific energy consumption in Group 3 based on the share of low oil seeds [5]

III. RESULTS AND DISCUSSIONS

In Table 5, the final results of the of energy consumption for the vegetable oil and oil extraction industry is given.

As it is observed, in order to consider the impact of the main effective parameters on the rate of electrical and thermal specific energy consumption, three Groups of energy consumption in vegetable oil and oil extraction industry is presented within STD relations.

Table 5. The final energy consumption for the vegetable oil and oil extraction industry [5]

Group 1	Electricity (kWh/ton)	STDe1 = 165 + SORx55 + SORxGPRx5 + SORxELRx200
	Natural Gas (m3 eq/ton)	STDt1 = 140 + SORx40 + SORxGPRx35
Group 2	Electricity (kWh/ton)	STDe2 = STDe1 + CRRxSTDe3
	Natural Gas (m3 eq/ton)	STDt2 = STDt1 + CRRxSTDt3
Group 3	Electricity (kWh/ton)	STDe3 = 260 + OLRx110
	Natural Gas (m3 eq/ton)	STDt3 = 235 + OLRx50

IV. CONCLUSIONS

In order to develop and specific energy consumption in different industries, having full data on all factories in a particular industry is very important. Since various geographical, economic, technical, cultural and social factors are effective on the method and rate of energy consumption in industries, so that the base of determining energy consumption is the local and native data of the country.

Auditing and detaching energy consumption and also collecting full data from the vegetable oil and oil extractions units in the country and processing the collected data taken from industrial units enabled us to select correct options for the of energy consumption for vegetable oil industry.

It should be noticed that in developing the energy consumption, various parameters are effective. The executives of the project have tried to include the maximum important parameters (such as the share of oil extraction, share of the production of solid oil and the share of gas plant and electrolyze-r in calculating the energy consumption in a logical relation.

ACKNOWLEDGEMENTS

We wish to thank the IFCO (Iran Fuel Consumption Optimization) for their support of the research. The author is grateful to Mr. Koocharian for his useful comments before the submission.

REFERENCES

[1] "Report on Situation of Oil Extraction and Vegetable Oil", Center for Researches of the Islamic Parliament, Monthly Review of Vegetable Oil in Iran, No. 1, pp. 4-7, January 2005.

[2] A. Koocharian, A. Haghparast, A. Bahri and F. Amini, "Energy Auditing in the Complex of Plantation and Industry of the North", Report of the Second Stage of the Project of Improvement of Load Coefficient of the Curve of electrical Consumption of Mazandarn Network, Research Center for Energy, Group of Energy and Consumption Management, 2004.

[3] "Energy Balance Sheet Year 2003", Office of Energy Planning, Office of Deputy for Energy Affairs, Ministry of Energy, 2004.
[4] "Report of Industry Sector - Food Industries (Vegetable Oil Industry in 2002", Iran Fuel Consumption Optimization (IFCO), Organization of Efficient Fuel Consumption, Ministry of Oil, 2004.
[5] R. Effatnejad, "Energy Consumption for Vegetable Oil Industry", Organization of Efficiency Fuel Consumption, 2007.
[6] "Result of the Study on the Food Industry: Section 6.1, Results of the Study at Behshahr Industrial Company", Japan International Cooperation Agency (JICA), 1995.
[7] "Energy Conservation in the Food Industry: Section 9.1, Energy Conservation in the Vegetable Oil Industry", Japan International Cooperation Agency (JICA), 1995.
[8] M. Avazadeh, "Consumption and Energy Efficiency in Nargese Shiraza Vegetable Oil Company", Institute of Energy International Studies, 1999.
[9] M.H. Zarbakhsh, "Energy Auditing in Pars Ghoo Vegetable Oil Factory", Energy Auditing Group, Iran's Energy Productivity Organization (SABA), Ministry of Energy, 1996.
[10] "The Guild of Vegetable Oil Industries of Iran, List of the Production Units of Vegetable Oil and Oil Extraction", The Guild of Vegetable Oil Industries of Iran, 2007.
[11] M. Avazadeh, "Consumption and Energy Efficiency in Nargese Shiraza Vegetable Oil Company", Institute of Energy International Studies, 1999.

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