

Optimization of Energy Consumption Pattern in Industrial Buildings and its Environmental Effects

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Received: June, 2009 Accepted: Sep., 2009

Extended Abstract

The Limitation of energy resources and its considerable consumption growth in Iran has doubled the necessity of optimization and conservation of energy in the country compared to the average consumption rate of energy in the world. Also the high consumption rate causes adverse effects in the environment. Heating systems are the main consumers of energy. Therefore, using a high efficiency method in different sections, especially industrial sections and warehouses seem to be necessary. In this regard, radiation heating systems have higher efficiencies compared to other methods. In the present research, assessment of the electrical energy and the gas consumed in a case study shows that (after optimizing the heating pattern) using this method causes fuel conservation of up to 75% and power conservation of up to 95% (compared to other heating systems) and can have a considerable impact in optimizing the consumption of energy and the environment. Powerhouse related activities result in producing pollutant gases such as So₂, Co₂ & NO_x and optimization of energy consumption means reduction of powerhouse emissions. Consequently it reduces destructive effects which energy production process imposes on the country's environment by the powerhouses. The results of extending the activities in the case study and optimization of heating pattern in similar building, shows a considerable reduction in social costs.

Review method

In this research, first we review the common heating method and an optimizing method for its replacement. Then, we shall compare the two heating methods and review the advantage of the new method compared to the conventional one. The emission of powerhouses result in releasing pollutants in the environment which we will describe their effects. In order to use the matters presented for justification of this heating optimization from the environmental view point.

In the case study which was performed in one of the production companies in northern Iran, the above mention heating pattern optimization was carried out in practice. Consumption of natural gas and electrical energy has been assessed separately in one of the main halls of the complex to show economical benefits of this action. In this assessment, the rates of energy consumption in the two methods (traditional & radiation heating systems) were calculated and compared to show the benefits of this optimization through economical aspect and also by considering subsidies paid by the government for energy and its industrial uses through national aspect. The expense-benefit table for this replacement can be a desirable basis for comparison to enable us to conclude from the actions taken.

Furthermore, by reducing the consumed energy, the powerhouses which are the important environmental pollutants, will impose less activities, the saving in social costs. The benefits related to the environmental issues will be calculated in order to show the effects of heating optimization on environment. By applying this method, we can test and prove the research goals which start that correcting and optimizing the heating pattern will have valuable environmental results for the organization and by extending them in national level, we can expect desirable outcomes.

*Archive OF SID***Convection heating**

In the Convection heating systems, the air is heated as medium fluid and warm air enters the environment. Because this warm air has a low density it occupies the upper spaces of the buildings and people who work at the floor level don't feel warm enough.

The heavy and cold weather occupies the floor and since warm weather is concentrated on the upper level and the difference between the two sides of ceilings and the outer walls increase energy losses from the walls and ceilings is increased considerably.

Radiation heating

One of the most efficient methods for heating halls is the radiation heating.

In an article with the of 'lets warm up the residents of buildings instead of the buildings themselves', Doctor Edward Hall says: "We make the buildings warm to people but this way will consume a lot energy compared to when warming up the people". Man lives in planet where has been absorbing energy for years through radiation. So it is possible to live in comfort by using at least one third of the present energy consumption

Table 1: Comparing radiation and Convection heating system

Radiation Heating System	Convection Heating System	
Radiation heating is not absorbed by the air and it is very suitable for buildings with much ventilation and air replacement and their door are opened and closed frequently.	Heating system, warm the air first and as a result the space is warmed. Frequent opening and closing doors results in considerable air replacement and much heat loss.	Heat Loss due to Air Replacement
Heat is transported by infrared waves with the possibility of setting the direction. By adjusting determining the direction correctly for the machines we can certainly avoid cold spots.	Setting heat direction for work place with this system is difficult and in some spots of the halls which are equipped with it will create cold spots and the heat is concentrated under ceiling.	Controlling Temperature Direction
By location Controlling of radiation heaters it is possible impose heating management and prevent heating of unnecessary spots and undesired zones.	Controlling air flow is difficult and as a result warm air flows to places which are not necessary and causes more heat loss and increases the related expenses.	Control through Zoning
The available radiation heaters reduce heat losses resulting from ceiling to minimum level because its reflectors will transport heat to the spots which need to be heated.	Warm air goes up and as a result ceiling of working place becomes warm. Poor insulations and seaming of ceiling will results in much energy loss and increases fuel expenses.	Heat Loss of Ceiling
Radiation heating system warm cold bodies directly without the necessity to heat the building space.	The system, warm the space gradually and to expedite the process and create more effects it is necessary to warm up the whole air volume of the room.	Time of Heating
It does not intensity air movement and does not create wind flow. It also reduces air pollution and is very suitable for spaces which need very clean air.	Flow of warm air moves dust and suspended materials undesirably and this rapid movement and replacement of air will have cold effects on the body practically.	Air Replacement <i>www.SID.ir</i>

Archive OF SID Environmental Effects

Environmental pollution effects in energy section is one the basic discussions of today's world. Accordingly the environmental damages of these activities could include water pollution, radio active radiation solid of dangerous pollutants, acid rains emission of green house gases, deterioration of ozon layer, global climatic changes and sound pollution. Moreover, the heating power can affect local and regional climatic qualities as the main of discharging air pollutants.

Furthermore utilizing fossil fuels causes discharge of sulfuric dioxide, oxides, carbon monoxide, carbon dioxide and suspended materials into air.

Different power plants have adverse effects on the environment especially the climate surrounding them during supply of the required electricity. In the below figure the network of effects of pollutants on the environment caused by power plants and the way they are related to each other are shown.

Fuel mechanism in power plants creates some of the pollutant gases such as SO_2 , CO_2 & NO_x , which has severe impacts on air. Based on the reports presented regarding the pollution rate and social costs of important power plants pollutant related to year 1384, a number of social expenses have been calculated for the year 1388 for three main pollutants considering EPA coefficients and according to the below table.

Table 2: The emission rate of different environmental pollutant by the country's power plants during 1388.

Total	CO2	SO2	NOX	
1000.9	744.73	25.44	230.73	Rials per 1 M3 of the Consumed Gas
197.11	121.69	8.65	66.77	Rials per 1 Kg/h of the Consumed Power

Conclusion and discussion

Optimum utilization of radiation heating systems in the halls of industrial and manufacturing units and the warehouses with the height of at least 2 meters will create savings of about 60% in fossil energy consumption. Also, it results up to 90% saving in the consumed electrical energy for supplying the required heat while reducing the expenses will considerably reduce environmental pollutions. This subject was reviewed during the auditing performed for the consumed gas and the electrical energy used in two traditional (Convection) and new (Radiation heating) methods and the resulting saving. The result of this process were also calculated and specified. At the end we can review the subject otherwise by a simple calculation to justify completely replacing radiation heating system for convection heating system, from economic point of view. Therefore, the return period of this project's investment can also be calculated. It should be noticed that the depreciated equipment of the convection heating system have specified values as well and their values have been considered zero in this case study.

$$20 \times 15000000 = 300000000$$

$$300000000 / 148195008 = 2 \quad (\text{year})$$

$$300000000 / 530237664 = 0.6 \quad (\text{year})$$

Total cost of Project
from company view (Case Study)
from country view (Subsidy)

Key Words

Optimization, Pattern, Energy Consumption, Radiation heating, Building