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Improvements of Energy Efficiency in Automobile Industries

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Abstract: Industries face a major challenge of energy loss, in assembly and manufacturing plants, energy expenditures are considered a small factor in the total production process. Reducing energy costs can have a greater impact on automobile industries by saving more on the production line. Energy efficiency can also reduce carbon emissions which can lead to degradation of the environment. This paper will focus on the motor vehicle assembly process, followed by barriers to energy then the opportunities for energy efficiency. Some of the barriers summarized are a lack of resources in terms of finance and information, outdated measuring techniques, lack of skilled personnel, lack of cooperation and commitment, and lack of staff awareness. opportunities to improve energy in industries such as energy efficiency programs, turning off machines and equipment when not in use, commitment and creation of awareness, financial allocation, Energy audit, data collection, and record, acquiring new technologies of measuring energy then commitment and continuous monitoring and control of energy are also focused.

Keywords: Motor vehicles, assembly process, energy efficiency; barriers; opportunities

1. Introduction

Motor vehicles are an essential part of our economy, satisfying a broad range of consumer mobility needs. Though they provide tremendous value to their owners, these vehicles are, nevertheless, conspicuous consumers of materials and energy, which has led to a great deal of effort to improve their efficiency and overall environmental performance.

While much work has focused on improved vehicle technology, considerable efforts should also be devoted to improvement of energy efficiency of vehicle HVAC and cooling systems. These systems pass through manufacturing processes and assemble in autoassembly plants. In both production process andassembly plants, energy expenditures is experienced.

Energy efficiency is the ratio between the useful energy outputs compared to the input, the aim of energy efficiency is to reduce the totalamount of energy required to produce goods and services. Energy uses in automobile industries include glass manufacturing furnaces and foundries milling and cutting degreasing, electroplating drying polishing ventilationboilers, and hot water systems. The biggest energy consumption in automobile industriesincludes processes such as heating to melt the substrate of metal and plastic [13]. Energy saving can help industries decrease the amount of bills spent on energy by 30%, it can also help to prolong the lifetime of the equipment and machines and reduce the downtime of maintenance by saving energy the industry can improve its reputation by demonstrating good responsibility of environment by reducing greenhouse gas emissions [13].

1.1. Vehicle assembly process

Assembly of components into the finished vehicle typically takes place on a mechanized conveyor involving as many as 1000 employees per shift, with additions of support personnel as needed. The largest segments of employees in the industry are inthis process type.

A vehicle assembly plant is divided into distinct units: the body shop, which can include subassembly activities also found in stamping; paint; chassis assembly; cushion room (which can be outsourced); and final assembly. There has been an increasing use of robots and mechanical applications in the industry. The body

shop has become increasingly automated, with reduced arc welding and the replacement of hand-operated spot-welding guns with robots [1]. The body shop of an assembly plant assembles the shell of the vehicle. In this setting, resistance welding is the primary process that may pose a hazard to workers. Arc welding and copper brazing are also employed to a limited degree.

The body parts of vehicles are generally formed using steel and other parts are made up using plastic and aluminium, steel alloys are used because of their market availability and low cost. In some application materials such as aluminium, fibre, glass and plastic are also used, for plastic is cheap and require less time to develop than steel components and can also be changed at a low cost, despite their cost per pound and their low weight contributes to higher fuel efficiency in cars.

Automobile bodies from the body shop enter the paint shop on a conveyor, where they are degreased, often by the manual application of solvents. They are then cleaned in a closed tunnel using caustic solutions and then undercoated. Paint is applied in a base coat and final color, and then cured in an oven. Painting helps to prevent corrosion improves the visual quality of the car and increases hardness.

2. Barriers to Energy Efficiency

2.1 Lack of staff management awareness

Most managerial staff have no idea of energy management which is why they do not allocate funds for energy because they think is a small portion of production. They normally consider the output in terms of units of production, they ignore small issues like air leaks from hose pipe they consider it as just air, little did they know that it has been compressed with energy, so little air loss can result in energy loss. Plant operators who assume that scrap rates are of no importance because scrap can be melted down and used again do not consider the excess energy consumption that this practice requires [2].

Other researchers have shown that the other barrier to energy conservation is a lack of awareness among industry managers of the potential gains from improved efficiency. Industries as well as the government are yet to take into consideration factors such as tax credits, depreciation benefits, electricity price escalation, life cycle savings of the investment, and timely release of money.

Sustaining the effort in energy management faces the same concerns as shifting priorities described above. Energy problems are handled with a crisis approach. After the perceived crisis passes or is superseded by other concerns, the effort devoted to managing energy is removed and placed elsewhere [3].

2.2 Outdated measuring techniques

Many industries have only one utility meter to measure energy consumption for the entire plant. Improper allocations of energy costs may distort financial decisions such as product pricing, income tax, declarations of production mix, compensation and bonuses, and capital investment allocations. But today advanced energy metering technologies can monitor actual consumption by substations within a facility, improving department's manager's abilities. The slow rate of progress in achieving higher standards of energy consumption in equipment and appliances is also affecting the adoption of energy savings measures. There is often a long –lifetime of energy-intensive industrial equipment such as kilns and furnaces [1].

2.3 Lack of cooperation among department

Each manufacturer's priority is to make production and sell them at good cost, all job descriptions and accountabilities are tied to making production. Departments within a company often compete against each other in the budget process. Energy efficiency is most likely expensed from the maintenance budget, but a lot of savings go to the production budget when departments do not cooperate, waste is allowed to continue unless top management acts energy efficiency is a duty that occupies the blank space on the personnel's minds [1].

2.4 Lack of skilled personnel.

A lack of skilled personnel can lead to difficulties in selecting and installing new energy-efficient equipment compared to the simplicity of buying energy. in many industries, there is often a shortage of o trained technical personnel as most of them are busy maintaining production. Also, the position within the company hierarchy of energy or environmental managers may lead to less attention to energy efficiency and reduced

availability of human resources to evaluate and implement new measures [4]. Opportunities for energy efficiency

3. Energy management.

According to [5], energy management is defined as the strategy of meeting energy demand when and where it is needed. This can be achieved by using systems and procedures to reduce requirements per unit of the output while minimizing the total cost of producing the output. To be effective, energy management should involve:

a. energy efficiency programs,
b. energy audit,
c. training,
d. benchmarking
e. commitment
f. resource allocation
g. voluntary agreements

The core business of energy management should beminimizing energy use, cost, waste and minimizing the environmental effects without affecting the quality and production of products.

3.1 Energy Efficiency Programs

Technology changes in equipment conserve energy changes in staff behaviors and altitude can have a great impact on energy conservation. Energy efficiency training programs can help Staff Corporation in energy management practices in their work. Every staff should be aware of the use and company objectives for energy efficiency improvements. Energy management information is mostly known to people of the lower level and never passed to the higher-level management. Energy efficiency programs with regular feedback on staff behavior, such as incentive systems, have had the best results. Though changes in staff behavior such as switchingoff lights or closing windows and doors often save only small amounts of energy at one time, taken continuously over longer periods they can have a much greater effect and end up saving more in the long run. Energy management programs can include metering, monitoring and control systems. Forming energy teams has been the way to successful programs in an organization thatconsists of people from different departments who have different knowledge and skills [5].

3.1.1 Training

Training on energy management should be conducted to create awareness among the new and old employees. The message can be communicated directly through email, presentation and training, posters, staff newsletter, walk rounds, stickers, word of mouth, displays, competitions, internal communication pays slips, energy literature and suggestion schemes. When communicating use, the appropriate language do not use technical language keep it simple and to the point a lot of technicality in the message may not be understood by the majority, also the communication channel shouldbe selected wisely. Monitoring of energy awarenessand review is also important throughout [6].

Staff can be trained about simple skills to be practiced daily such as the benefit of switching off the light when not in use, which if done continuously for a longer period can save more energy.

3.1.2 Energy audit

Energy audits involve verification, monitoring and analysis of the use of energy and submission of technical reports containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption [3]. An energy audit is conducted to understand how energy is used within the organization and to find opportunities for improvement and energy saving. It can also be conducted to evaluate the effectiveness of an energy efficiency project or program.

Energy audits provide the best way to identify air leaks in the industry. While some utilities and local governments offer free energy audits, it may beworth the expense of hiring a professional energy auditor to do a comprehensive assessment. When done by a certified auditor, the comprehensive energy audit will go beyond

identifying obvious energy upgrades [7]. Auditing can also determine the efficiency of heating and cooling systems; the auditor will create a roadmap of where and howbest to make improvements in the industry. It is recommended that you collect some information in advance to share with the auditor, typically including the last twelve months of your utility bills.

The type of industrial energy audit conducted depends on the function, size, and type of the industry, the depth to which the audit is needed, and the potential and magnitude of energy savings and cost reduction desired. Types of audits can be classified into three categories: a preliminary audit (walk-through audit), general and detailed audit (diagnostic audit).

The preliminary audit is the simplest audit to conduct it requires less time because it uses the data that is readily available.It does not require a lot of measurement, data collection, or detailed interviews, it focuses on major energy supplies and demands of the industries the result from this audit generally provides common opportunities for energy efficiency.

Detailed audit (Diagnostic audit), for this audit more detailed information is required. A lot of measurement, detailed data collection, a n d inventoryof every system available in the organization. The time required for this audit is longer hence the results of these audits are more comprehensive and useful since they give more detail of energy useon specific systems and improvement opportunities for each system.

3.1.3 Benchmarking

Benchmarking is an effective means of raising management awareness of internal energyconsumption trends and provides a means to compare the energy use of one company or plant to the other that is producing the same products[4]. benchmarking is significant to energy management activity. It supports organizations in governing whether improved energy performance should be estimated for a facility, procedure, or piece of equipment and assiststhem in achieving their energy reduction objectives setting and in providing them with a method to estimate the practicality of such goals. The incorporation of management plans and benchmarks can enable an organization to advance its level of energy performance hence saving money and reducing greenhouse gas emissions [13].

3.1.4 Commitment

The management must formulate, communicate and embrace the organization's energy management policy. The policy should set the tone for the entire organization and establish a firm commitment to energy efficiency. The management should be committed to energy management by conducting regular management reviews, these should be determined by energy indicators, and project completed resources needs and future planning, [8].

3.1.5 Resource Allocation

At the end of the financial year, a portion of the money should be allocated for energy management. This money should assist in employing experts on energy, implementing energy programs, collecting data, maintaining equipment and for continuous control and monitoring. The money should be given directly to the energy department.

3.1.6 Voluntary agreements

This is a contract between the government or any other regulating body and a company. The company may promise to attain certain energy efficiency improvements like emission reduction the government on the other hand may promise to financially support the company [4].

3.2 Housekeeping.

Good housekeeping means having all the items in their proper place and removing the unnecessary items. Good housekeeping helps avoid accidents such as slips, trips and falls. it also reducesharmful materials from entering the rooms as dust pollen and vapors which can accumulate in walls making them less reflective hence increasing energy use in the room. Good housekeeping reflects a well-managed organization and it can impress all who enter there hence increasing product sales.This can be achieved by:

a. Light controls
b. Turning off unnecessary compressed air
c. Use sources other than compressed air.
d. Keep the windows and doors closed.

3.2.1 Light controls

Lights should be turned off when not in use, this can be done manually by advising the occupant to switch them off. Natural lights like sunshine can be used during the day instead of using electricity.They can be controlled through automatic controls like using sensors that turn off the light whenthe room is unoccupied or when the natural light sets in, Increasing levels of daylight within rooms can reduce electrical lighting loads by up to 70% in some cases [9] by replacing incandescent lights with fluorescent lights or compact fluorescents can still save energy, fluorescent lamps lasts ten times longer than incandescent light.

3.2.2 Turn off unnecessary compressed air.

Equipment that is no longer using compressed air should have the air turned off completely. This can be done using a simple solenoid valve, Compressedair distribution systems should be checked when equipment has been reconfigured to be sure no air is flowing to unused equipment or obsolete parts of the compressed air distribution system [10].

3.2.3 Use sources other than compressed air.

Many operations can be accomplished more economically and efficiently using energy sources other than compressed air. Some industry Engineersbelieve this measure has the largest potential for compressed air energy savings, such as when cleaning parts or removing debris brushes, blowers or vacuum pump systems should be used instead ofthe compressed air blow guns can be used for low-pressure air instead of high pressure compressed [10].

3.2.4 Keep Doors and Windows Closed

Keep your windows closed when the heat is on to retain it, Having the heat on and windows open at the same time is a waste of heat close blinds after the sun goes down to keep more heat in your room during the winter and also keep your blinds down in the summer to keep the heat from coming into through the windows in the summer. Keep the doors insulated and sealed well to prevent leaks through or around them. Installing insulated doors storms and replacing windows with energy-efficientones can also prevent air leaks and energy bills.

3.3 Equipment labeling

Product labeling makes information about equipment performance characteristics, such as energy consumption and operating costs, easily available. Labels assist equipment purchasers in making informed decisions while increasing theattention paid to energy use. Labels are especially useful for small items, which are often purchased without much study, such as pumps, fan compressors, and small boilers. Labelling also helps the end user of the equipment to supply it with the required power and thus can prolong the life span of the equipment. When buying any equipment, it is recommended to define its need and read the energy efficiency rating (EER) it enables one to buy the products, compare the operating cost and determine which equipment is good. In most cases, more energy-efficient equipment costs more than theone that is less efficient, but the result is significant over the life of the equipment [11].

3.3.1 Energy Teams

Forming an energy team is a sign of energy efficiency emphasize, it should be responsible for planning, implementing, benchmarking, monitoring and evaluating the energy management programs. It can also train, conduct research, communicate results and come up with the way forward of energy management. The team members should be allocated duties, and they should have roles andresponsibilities the aim and objective of the

team should be clear. The energy team should include members from each division in the company and he should participate fully both in meetings and training. It should also conduct an audit and come up with best practices and actions to be implemented in the industry and identify key opportunities for energy efficiency improvements, the progress should becommunicated to the line managers and employees and a recognition and rewards program should be put in place. They should also come with mechanisms and equipment for tracking and communicating the progress across the organization [12].

3.4 Energy Monitoring and Control Systems

Energy monitoring systems are key tools that play an important role in energy management. It may include energy sub-metering at the component, equipment, or process level and can be used to track various end uses of energy over time for energy efficiency improvement analysis. These systems can play a key role in alerting energy teamsto problem areas and in assigning accountability forenergy use within a facility. Energy monitoring systems can provide useful data for corporate greenhouse gas accounting initiatives. Energy monitoring and metering systems can also help companies participate in emergency demandresponse programs, in which utility companies provide financial incentives to customers who reduce their energy loads during peak demand times [12].

3.4.1 Records of Energy Data

Data is very important in energy monitoringwithout data the industry may not be aware of how energy is consumed and the percentage lost. All the data collected should be kept as a source of reference.The data can be collected using well-calibrated and maintained equipment for higher efficiency; also, they can use some software. Data can be tracked monthly, seasons and years then comparisons can be made and the root source of energy loss can be investigated quickly [6].

4. Conclusions

This paper presents the Vehicle assembly processes, barriers to energy efficiency and opportunities for energy efficiency in automobile industries. The paper provides direction and a basis for future decision-making on energy savings and identifying the loopholes for energy loss. Some of the opportunities can be achieved soon others require longer time investment and further research and investigation. However, all the efforts depend on the company's response to energyefficiency.

It is recommended that:

- Organizations should take the initiative to collaborate with the government to take advantageof their tools and laboratories.
- Effective communication of new technologiesshould be embraced and methods of reducing energy should be communicated to managers to create awareness.
- Coming up with policies to increase energy efficiency without interfering with the normal operations and the savings of the company, and overcoming the barriers to energy efficiency is greater challenge.

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