Energy Efficient Technologies and Best Practices in Steel Rolling Industries (Indonesia)

Executive summary

The manual 'Energy Efficient Technologies and Best Practices in Steel Rolling Industries' focuses on energy-efficiency improvement options in steel rolling mills in Indonesia. It outlines technological options and practices, which may be adopted to enhance the efficiency of the existing installations as well as for augmentation of the capacities. The manual has been prepared by TERI based on the field assessment studies undertaken during September-November, 2014 in selected steel rolling mills in Indonesia. The adoption of new and modern technologies will not only help the Indonesian steel rolling industries to be competitive at the global level but also help in reducing the emission levels.

The manual is expected to act as a knowledge resource for the industry personnel and energy practitioners for incorporating energy efficient options in their regular operating procedures. The total energy consumption of Indonesia in the year 2012 was about 162 million tonnes of oil equivalent. Industrial sector contributes to the final energy consumption of 29.9%, closely followed by households (28.5%) and transportation (26.8%). Thus, the industry sector is one of the important consumers of commercial energy, which is mainly attributed to significant development in textiles, automobiles, infrastructure, and other associated sectors. The steel industry is also one of the leading sub-sectors with expectations of increased investments and competitiveness in the coming years.

The domestic demand for crude steel in Indonesia was about 8.6 million tonnes in 2011; while domestic production was 6.01 million tonnes. Indonesia is ranked 36th in the world in terms of steel production. The per capita consumption of steel in the country has increased from 22.8 kg to 62.3 kg during the last decade (2003-2012). However, per capita consumption of the country is still lower than the per capita consumption of Asian countries (262 kg).

The downstream steel industries sector, which comprises various finishing operations, is an extremely important sub-sector, but largely remains unattended. One of the important finishing operations in steel sub-sector is steel rolling mills. There are about 72 steel mills operational in Indonesia. A detailed field assessment study in a few typical steel rolling industries (selected on the basis of installed capacity, energy consumption, technology used, raw materials and products) located in Surabaya (East Java) and Cilegon (Banten) was carried out by TERI.

Steel rolling industries are highly energy intensive and the specific energy consumption of the four units that were studied was in the range of 2.36–4.37 Giga Joule per tonne. The weighted average specific energy consumption is estimated to be 3.13 Giga Joule per tonne of rolled steel for hot rolling, whereas the world average is about 2.2 Giga Joule per tonne, which indicates significant potential for energy conservation and energy efficiency improvements. Summary of the key findings from the field assessment is given below:

- A wide variation in the specific thermal energy consumption was observed, which is mainly attributed to age of the furnace, technology employed, and capacity utilization.
- Natural gas is the primary fuel used in the reheating furnaces across the country due to lower price in comparison with other developed countries as well as easy availability. Reheating furnaces are the major consumers of energy in the form of

thermal energy, accounting for about 60–65 per cent of total energy consumption of rolling industries.

- The utilities associated with reheating furnaces and rolling mills (compressed air system, process cooling system, etc.) are of conventional type and the efficiency levels were not up to the design mark. This is mainly due to lack of proper selection of equipment, over designing, absence of periodic maintenance practices, and lack of adoption/awareness about new and energy-efficient technologies. The use of modern era technologies and process automation and control system can lead to substantial reduction in energy consumption and greenhouse gas (GHG) emissions.
- The average GHG emissions have been estimated based on the type of fuel used and its share in the total consumption. The emission level from steel rolling industries in Indonesia is estimated to be 363 kg CO_2 per tonne of product.

Various energy efficient technology options have been identified for reheating furnaces, rolling mills, and auxiliaries. These options are summarized below.

Reheating furnace

- Recovery of heat – Regenerative burners
- Recovery of heat – Self-recuperative burners
- Oxy-fuel combustion technology
- Hot charging of continuous cast billets
- New reheating furnace technology – Walking beam furnace
- Optimization of combustion – Oxygen level control and VSDs on combustion fans
- Improved insulation and refractories of reheating furnace
- Optimization of operation – Furnace pressure
- Optimization of operation – Temperature of material
- Optimization of operation – Capacity utilization

Steel rolling mill

- Capacity optimization and use of energy efficient electric motors
- Improved lubrication system
- Minimum waste – crop length optimization
- Use of cast-in-carbide rolls
- Anti-friction roller bearing
- Computerized roll pass design

Auxiliaries

- Process cooling system – Automation and control and use of Energy efficient pumps
- Compressed air – Optimum pressure, capacity utilization and prevention of leaks
- Ultra high efficiency transformers
- Quantity control of transformers
- Energy efficient lighting

Modern technologies such as enhanced recovery of the waste energy and optimum use of auxiliary system provide opportunities for minimizing heat input to reach up to the required temperature profiles in reheating furnaces. Along with technological advancements, adoption of control and automotive process technology and adhering to regular and preventive maintenance practices will help in improving the performance of reheating furnaces and rolling mills.

A large number of steel rolling mills in Indonesia are equipped with small and medium capacity reheating furnaces (typically up to 40 tonnes per hour). High-end technological options may not be the appropriate solution for such mills as large investment would be required resulting in high payback periods. Instead, these mills can improve the performance through adoption of energy-efficient technologies and practices provided in this manual. High investment technologies such as regenerative burner technology may be suitable only for rolling industries having reheating furnaces of capacities more than 40 tonnes per hour or more and utilization factor in the range of 75%–100%. As per the information collated during the field interaction, the number of such mills present in Indonesia is very limited.

This manual describes the general methods for energy saving as well as success stories and practical examples that can serve as reference for the industries and energy practitioners, who deal with the operation of rolling mills. The primary objective of the manual is to highlight the energy-efficient technologies and best operating practices that can be adopted/implemented to save energy and reduce GHG emissions. Also, creating awareness on improved technologies and best operating practices among industry stakeholders is one of the goals of the project.

The manual discusses both the measures, which may be retrofitted in the existing system as well as replacement options for minimizing energy consumption. The technical options are provided along with their applicability, availability, investments, energy usage, and monetary benefits. Suitable case studies have also been provided to validate the worldwide use of the suggested technologies. Special emphasis has been given in the manual on best operating practices and Operations and Maintenance (O&M) guidelines that should be followed in reheating furnaces, rolling mills, and other utilities. It is envisaged that this document will help various stakeholder industries to adopt suitable technologies and practices in their mills.

The industries in steel rolling sector will have to scrutinize the level of technology used and their specific energy consumption to assess the current level of performance. The preliminary analysis would help them to decide on the changes required to achieve optimum performance levels and remain competitive with international market. Industries may also seek the help of energy practitioners and technology suppliers for detailed plant specific performance assessment studies.

Modification in existing designs, retrofits of control and automation systems and adoption of new technologies along with improved O&M practices and monitoring can lead to a significant reduction in operating and maintenance cost of the facilities. An energy saving potential of 20%–35% exists in rolling industries of Indonesia. The realization of this potential will not only lead to reduction in energy consumption and energy costs for the mills but also contribute to the overall international goal of reducing the GHG emissions from various sources.