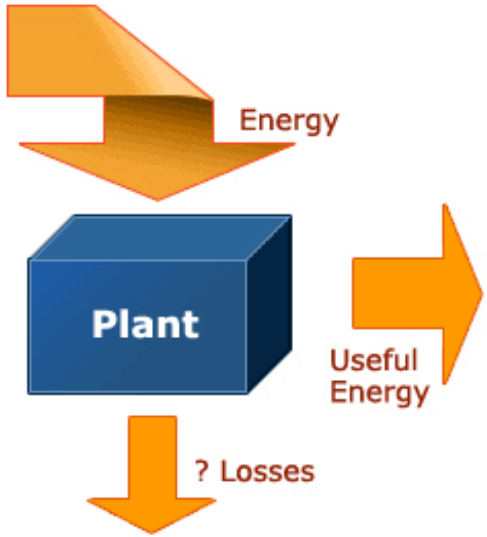
ENERGY AUDITING

Energy Audit

Investigation of all facets of a facility's historical and current energy use to identify and quantify energy waste

Output is viable and cost-effective energy saving measures to reduce energy consumption per unit of product output and lower operating costs.



Coverage of Energy Audit

- Energy conversion –transformers, pumps, fans, compressors lighting etc.
- Energy distribution – electricity, compressed air, water etc.
- Energy utilization efficiency of equipment – kilns, dryers, forming/Press m/c's, conveyors
- Production planning, operation, maintenance, and housekeeping
- Management –information flow, data collection, data analysis, feedback, achievements, training of employees, and motivation, etc.
- Others such - waste minimization studies

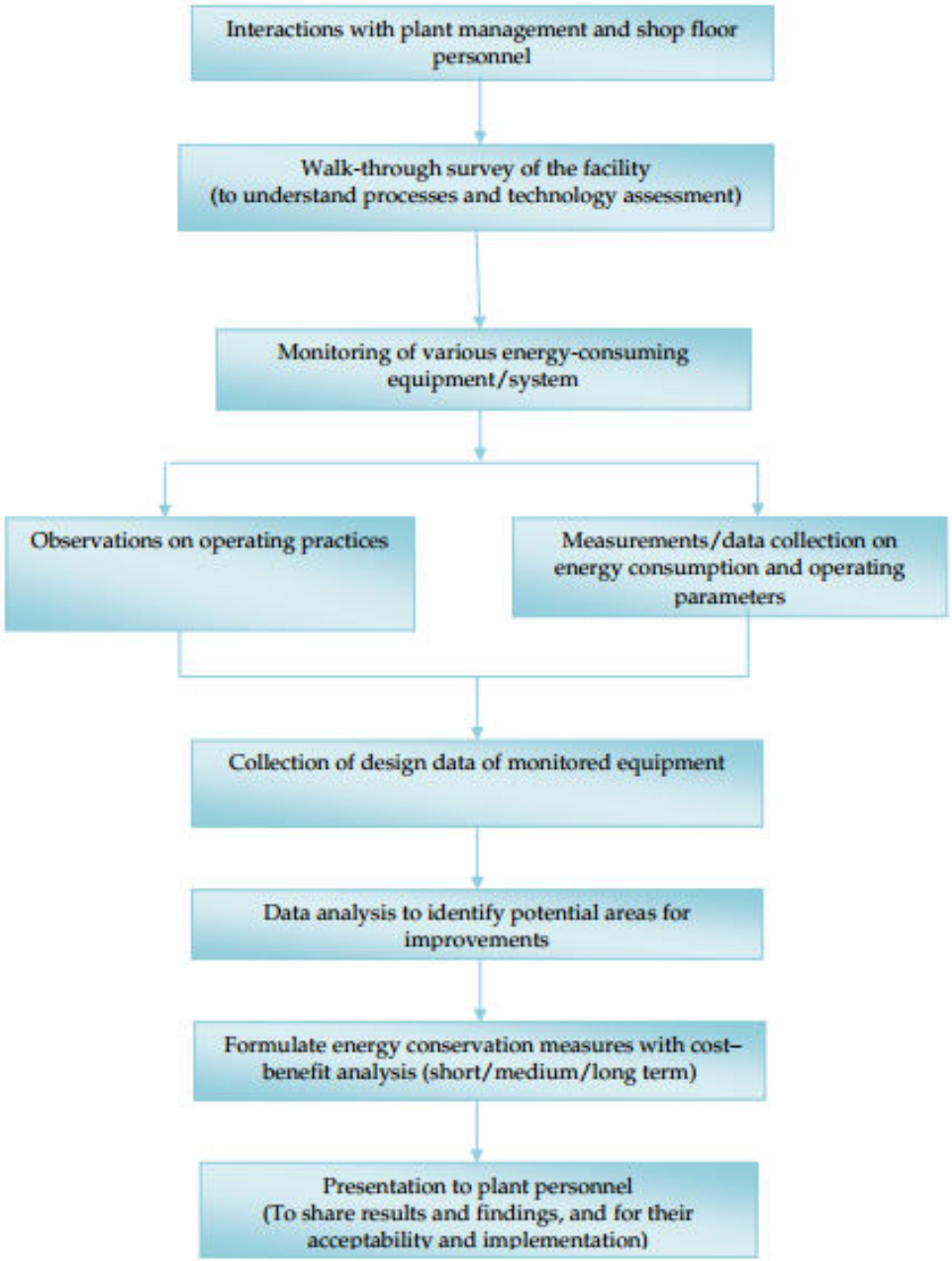
Preliminary energy audit

- Familiarization of process/plant activities
- First hand observation and assessment of current level operation and practices
- Identify potential areas (equipment/system) for energy saving
- Identify immediate energy conservation measures that require marginal or no investment
- Shortlist potential areas for more detailed assessment

Detailed energy audit

- Collection of details of technologies, processes and equipment, and preparation of process flow chart
- Collation of design, operating data, and schedule of operation of different equipment
- Estimation of details of production, yield, rejections, and waste generation
- Details of different types of energy source, consumption, and tariff.

Broad steps of energy audit



First Steps

- Analysis of the energy consumptions and costs, for the last 12–24 months for each energy type (electricity, natural gas, coke, etc.)
- Facility layout, the type and operating hours of the production and services plants,
- Equipment list – process (melting, moulding etc. and general energy-consuming equipment such, air compressors, etc.
- Measuring data (using power/energy meters and/or a data logger systems to monitor the energy consumptions or energy-related parameters
- Analysis of the energy consumed by the equipment
- Preparing energy balance for each system/equipment

Energy Audit Coverage

Electrical System:

PF Improvement study
Electrical Distribution system (substation & feeders study)
Motor loading survey
Lighting system

Mechanical System:

Conveyors
Ball mill/blungers
Kilns
Spray dryer
Press machine
Compressed air System
Pumps and pumping System
Fans & Blowers

Information to be collected during detailed energy audit

- Plant layout
- Sources of energy supply (e.g. electricity from the grid or self-generation)
- Energy cost and tariff (month wise energy consumption data for 1–3 years) and corresponding production data (1–3 years)
- Energy consumption by type of energy, by department, by major equipment, by end-use
- Process flow diagram with energy and material flows
- Generation and distribution of site services (e.g. compressed air, steam, chilled water, cooling water, etc.)
- Material balance
- Energy management procedures
- Energy awareness training programmes.

Questions which an Energy Auditor should ask

- What function does this system serve?
- How does this system serve its function?
- What is the energy consumption of this system?
- What are the indications that this system is working properly ?
- If this system is not working, how can it be restored to good working conditions/
- How can the energy cost of this system be reduced?

Baseline Data (for detailed energy audit)

• Technology, processes, and equipment details • Capacity utilisation • Amount and type of input materials used • Water consumption • Fuel consumption	• Electrical energy consumption • Type and quantity of wastes generated • Percentage rejection / reprocessing • Efficiencies / yield

Manufacturing process of a typical Ceramic Industry

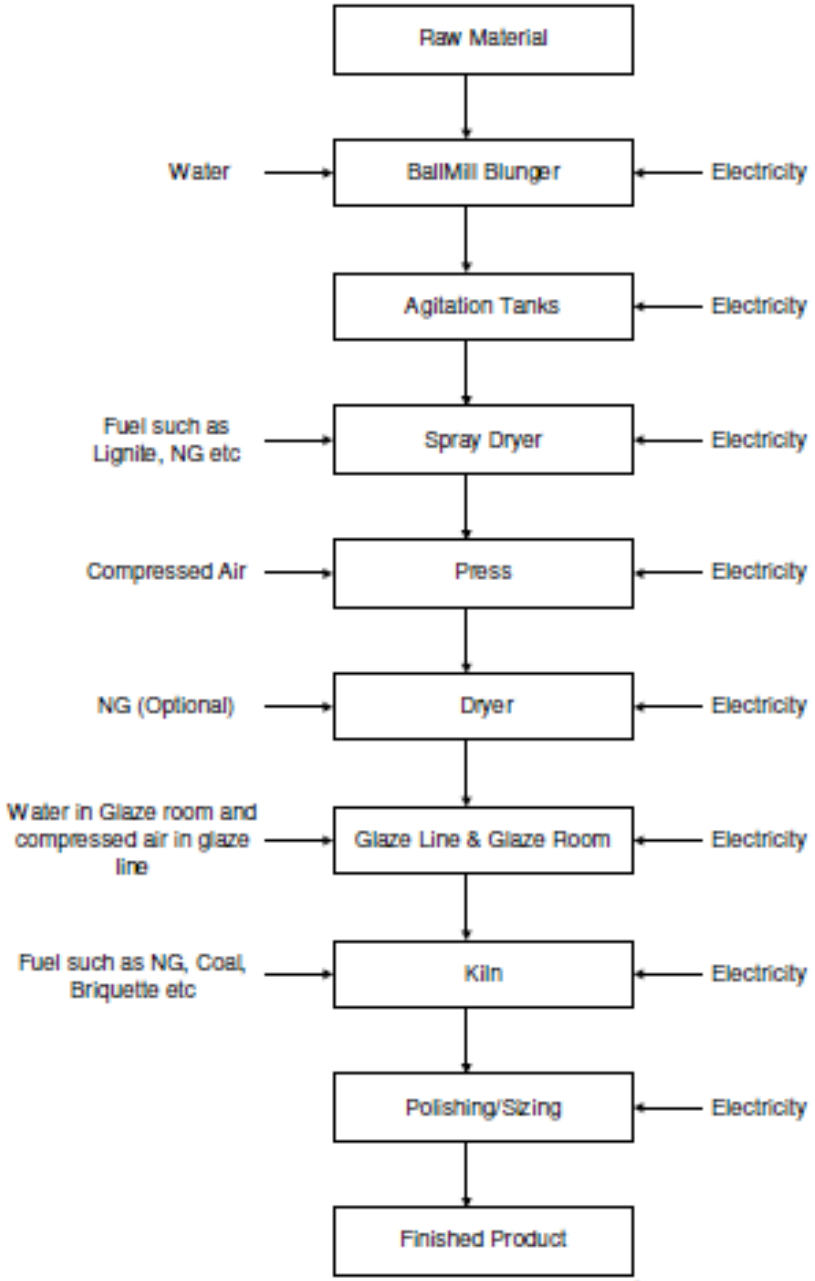


Figure No. 1: Process Flow Diagram of Wall/Floor/Vitrified Tiles

Major energy consuming equipment

- Kiln
- Press machine
- Ball mill/Blunger
- Dryer
- Compressors
- Blowers
- Pumps

Energy consumption of different processes in ceramic products manufacturing

Process	% of total energy consumption
Raw material preparation	6
Spray drier	7
Press machine	5
Glazing machine	4
Kiln	60
Utilities	12
Miscellaneous	6

SEC levels in Indian Ceramic Industry

Electrical specific energy consumption (kWh/Tonne)	Thermal specific energy consumption (MKcal/Tonne)
210	1.34

ENCON Opportunities

Housekeeping and Operational Measures

- Do not operate the material transporting conveyor when there is no material to be transported.
- Run the ballmill at optimum speed to save energy and ensure proper mixing.
- Check the mesh size of the slurry - when it reaches the required value, switch off ballmill/ blunger.
- Optimize particle size of the pulverized coal in spray dryer
- Maintain the required temperature in different zones of the kiln so as to follow the ideal firing schedule.
- Optimise product loading in kiln
- Adjust air-to-fuel ratios in kiln
  - A 5% reduction in the level of excess air (recommended excess air percentage) increases kiln efficiency by 1%. Similarly, a 1% reduction of residual oxygen in the flue gas reduces fuel consumption by 1%.

ENCON Opportunities

Low and Medium Cost Measures

- Use material of a low thermal mass for constructing the kiln car.
- Use ceramic fibre blankets at the base of the car instead of refractory base case
- Air present in the rapid cooling zone is at a temperature of about 550^0C. This heat can be recovered by installing a recuperator system
- Fit time delay switches on all grinding and milling machines so that they are automatically switched off if no material is being processed.
- Mechanize the process to enable continuous feeding to the ballmill. This will reduce the ballmill's operating time and also that of its auxiliaries as well as overall energy consumption.

Recommended excess air levels for different fuels and burners

Fuel	Type of Furnace or Burner	Excess Air (% by wt)
Pulverized coal	Completely water-cooled furnace for slag-tap or dry-ash removal	15-20
	Partially water-cooled furnace for dry-ash removal	15-40
Coal	Spreader stoker	30-60
	Water-cooler vibrating-grate stokers	30-60
	Chain-grate and traveling-grate stokers	15-50
	Underfeed stoker	20-50
Fuel oil	Oil burners	15-20
	Multi-fuel burners and flat-flame	20-30
Natural gas	High pressure burner	5-7
Wood	Dutch over (10-23% through grates) and Hofft type	20-25

Classification of Energy Efficiency Measures

Category I

Housekeeping measures which are improvements with practically no cost investment and no disruption to the facility operation.

Category II

Changes in operation measures with relatively low cost investment.

Category III

Relatively higher capital cost investment to attain efficient use of energy.

Presenting Audit Findings

- Energy auditors may not have time to carry out detailed analysis at site.
- Presentation of highlights of the audit with key findings before leaving site
- Draft or working report
- Acknowledgment of energy saving measures identified in the site.

Submission of Audit report

- Refine and revalidate ENCON measures off-site
- Accurate estimate of energy savings
- Possibly another presentation as final appraisal

Typical contents of energy audit report

Acknowledgment

Executive Summary

Energy saving options at a glance and recommendations

1.0 Introduction about the Plant

- General plant details and descriptions
- Energy audit team
- Component of production cost (raw materials, energy, chemicals, manpower, overhead, others)
- Major energy use and areas

2.0 Production Process Description

- Brief description of manufacturing process
- Process flow diagram and major unit operations
- Major raw material Inputs, quantity, and costs

Typical contents of energy audit report

3.0 Energy and Utility System Description

- List of utilities
- Brief description of each utility
  - Electricity
  - Compressed air
  - Cooling water
  - Water

4.0 Detailed Process Flow Diagram and Energy & Material Balance

- Flow chart showing flow rate, temperature, pressures of all Input /output streams
- Water balance for entire industry

Typical contents of energy audit report

5.0 Energy Efficiency in Utility and Process Systems

Specific energy consumption
Kiln efficiency assessment
Furnace efficiency analysis
DG set performance assessment
Compressed air system performance
Electric motor load analysis
Lighting system

6.0 Energy Conservation Measures & Recommendations

List of options in terms of no cost/low cost, medium cost and high investment cost, annual energy and cost savings, and payback
Implementation plan for energy saving measures/projects

ANNEXURES

List of energy audit worksheets
List of instruments
List of vendors and other technical details

Summary of Energy Saving Recommendations

S. No.	Description of energy saving measure	Annual Energy (Fuel & Electricity) Savings (kWh/MT or KL/MT	Annual Savings Rs. Lakh	Capital Investment (Rs. Lakh)	Simple Payback period
1.					
2.					
3.					
…					
Total					

Types and Priority of Energy Saving Measures

Category	Type of Energy Saving Options	Annual Electricity / Fuel Savings kWh/MT or KL/MT	Annual Savings (Rs. Million)	Priority
A	No Investment (Immediate) - Operational Improvement - Housekeeping			
B	Low Investment (short to medium term) - Controls - Equipment modification - Process change			
C	High Investment (long term) - Energy efficient devices - Product modification - Technology change			