

**Table 2. Information currently measured at Erel Cement and suggested improvements related to energy**

| No | Section                      | Data Measurements – existing situation   |   |  |   |  | Additional data required  | Instrument required  |
|----|------------------------------|--|---|--|---|--|---|--|
|    |                              | Information  | Who measures  | Where measured   | When measured   | Information receivers  |   |  |
| 1  | Crusher (primary and hammer) | Number of dumpers  | Receiver  | Weighing point   | Every time when it arrives  | Shift supervisor-economist-chief engineer  | - Electricity consumption: kWh<br>- Specific consumption: kWh/tonne<br>- Dust loading in exhaust: grams/m3 of exhaust   | Energy meter<br><br>Portable SPM Analyzer <sup>1</sup>   |
| 2  | Raw mill                     | Weight of 1litre of slurry, particle size, titration, moisture of slurry<br><br>Produced slurry<br><br>Iron ore: Moisture, content, chemical content, quantity received                                | Shift laboratory staff<br><br>Analytic chemist Receiver                         | Raw mill<br><br>Vertical slurry tank<br>Every dumber   | Every hour<br><br>In each shift<br><br>Every time when it arrives | Machinist-shift supervisor-economist-chief engineer<br>Technology engineer<br>Shift supervisor-Economist-accountant  | - Electricity consumption: kWh<br>- Specific electricity consumption: kWh/tonne crushed<br>- Ball wearing rate for each mill separately: Grams/ tonne of raw meal<br>- Dust loading: grams/m3 of exhaust  | Energy meter exists but must be calibrated<br><br>Portable SPM Analyzer  |
| 3  | Coal mill                    | Moisture and of coal<br><br>Particle size and moisture of coal before mill<br><br>Moisture of coal after mill<br><br>Average moisture and particle size of the day<br><br>Chemical composition of coal | Shift laboratory staff<br><br>Analytic chemist                                  | Each wagon<br><br>In each input<br><br>Each output<br><br>Mixture of masterpiece<br>Average of mixture | Every 2 hours<br><br>Daily<br><br>Monthly                         | Shift supervisor-technology manager-master-machinist-director of kiln section-economist-chief engineer-director<br><br>Technology engineer-chief engineer-economist<br>Technology engineer, Mining Company, chief engineer | - Electricity consumption: kWh<br>- Specific electricity consumption: kWh/tonne coal crushed<br>- Coal consumption: tonnes<br>- Ball wearing rate for each mill separately: Grams/ tonne of raw meal<br>- Dust loading: grams/m3 of exhaust   | Energy meter exists<br><br>Tachometer at screw feeders<br><br>Portable SPM Analyzer  |
| 4  | Kiln                         | Weight, CaCO3, moisture, and water content of slurry<br><br>Weight of clinker, Stability, mark and coagulation of slurry<br><br>Chemical component of slurry   | Shift laboratory staff<br><br>Mechanic Laboratory staff<br><br>Analytic chemist | Horizontal slurry tank<br><br>Kiln, cooler   | Every 2 hours<br><br>Daily  | Shift supervisor-technology manager-machinist-director of kiln section<br>Technology engineer-chief engineer   | - O2 before and after cyclone: percentage (1)<br>- Surface temperature: oC (2)<br>- Electricity consumption: kWh<br>- Specific electricity consumption: kWh/tonne clinker (3)<br>- Specific coal consumption: kg / tonne clinker<br>- Dust loading at clinker section (drag chain conveyor) and at chimney: grams / m3 in | (1) Portable combustion analyzer & Orsat apparatus at lab<br>(2) Non-contact surface temp indicator<br>(3) Energy Meter<br>(4) Portable SPM Analyzer |

<sup>1</sup> Only two Portable SPM Analysers are needed. One at the kiln, and a second one for other areas.

| No | Section            | Data Measurements – existing situation  |   |   |   |  | Additional data required  | Instrument required   |
|----|--------------------|---|---|---|---|--|---|---|
|    |                    | Information   | Who measures  | Where measured  | When measured   | Information receivers  |   |   |
|    |                    |   |   |   |   |  | exhaust gas (4)   |   |
| 5  | Cement mill        | <ul style="list-style-type: none"> <li>Particle size, coagulate, mark</li> <li>Average particle size, stability, volume</li> <li>Quantity of produced cement</li> <li>Chemical composition of cement</li> <li>Coagulation + SO3</li> <li>Moisture content and chemical content, received quantity of gypsum</li> </ul>  | <ul style="list-style-type: none"> <li>Shift laboratory staff</li> <li>Mechanic</li> <li>Laboratory staff</li> <li>Shift technology engineer</li> <li>Analytic chemist</li> <li>Receiver</li> </ul> | <ul style="list-style-type: none"> <li>Masterpiece point</li> <li>Vertical tank of cement</li> <li>At wagons</li> </ul> | <ul style="list-style-type: none"> <li>Every hour</li> <li>Daily</li> <li>Every time</li> </ul> | <ul style="list-style-type: none"> <li>Technology engineer</li> <li>O-Shift Supervisor-Technology engineer-Chief engineer</li> <li>Technology engineer-economist-Chief engineer-Director-EREL company</li> <li>Technology engineer-economist-accountant</li> </ul> | <ul style="list-style-type: none"> <li>- Electricity consumption of each mill: kWh</li> <li>- Specific electricity consumption of each mill: kWh/tonne cement</li> <li>- Ball wearing rate for each mill separately: Grams/ tonne of cement</li> <li>- Time between ball charge of each mill: operating hours</li> <li>- Dust loading: grams/m3 of exhaust</li> </ul> | <ul style="list-style-type: none"> <li>Energy meter exists but must be calibrated</li> <li>Portable SPM Analyzer</li> </ul> |
| 6  | Packaging          | <ul style="list-style-type: none"> <li>- Coagulation</li> <li>- Stability of cement</li> <li>- Chemical composition of cement</li> <li>- Accounting of dispatched cement</li> </ul>   | <ul style="list-style-type: none"> <li>Shift laboratory staff</li> <li>Analytic chemist</li> <li>Shift Supervisor</li> </ul>  | <ul style="list-style-type: none"> <li>At each transport</li> <li>Cement reserve</li> </ul>                             | <ul style="list-style-type: none"> <li>Daily</li> </ul>   | <ul style="list-style-type: none"> <li>Shift supervisor-Marketing manager-economist-chief engineer-director-EREL company</li> </ul>  | <ul style="list-style-type: none"> <li>- Electricity consumption: kWh</li> <li>- Specific electricity consumption: kWh/tonne dispatched</li> <li>- Dust loading: grams/m3 of exhaust</li> </ul>   | <ul style="list-style-type: none"> <li>Energy meter</li> <li>Portable SPM Analyzer</li> </ul>                               |
| 7  | Compressor         | <ul style="list-style-type: none"> <li>- Pressure of oil</li> <li>- Air generator pressure</li> <li>- Voltage</li> <li>- Current</li> <li>- Cooling period</li> </ul>   | <ul style="list-style-type: none"> <li>Operator</li> </ul>  | <ul style="list-style-type: none"> <li>Control board</li> </ul>   | <ul style="list-style-type: none"> <li>Hourly</li> </ul>  | <ul style="list-style-type: none"> <li>Shift supervisor-Energy manager-chief engineer</li> </ul>   | <ul style="list-style-type: none"> <li>- Electricity consumption of each compressor: kWh</li> <li>- Operating hours of each compressor</li> </ul>   | <ul style="list-style-type: none"> <li>Energy meter</li> <li>Hour meter</li> </ul>  |
| 8  | Electricity        | <ul style="list-style-type: none"> <li>- Quantity of electricity consumed as per the bill</li> <li>- Allocation of electricity consumption to the different sections</li> </ul>   | <ul style="list-style-type: none"> <li>Energy Engineer</li> </ul>   | <ul style="list-style-type: none"> <li>Monitor station</li> <li>Electrical sub-station</li> </ul>                       | <ul style="list-style-type: none"> <li>Monthly</li> </ul>                                       | <ul style="list-style-type: none"> <li>Shift supervisor-economist-chief engineer-director</li> </ul>   | <ul style="list-style-type: none"> <li>- Electricity consumption of each section: kWh</li> <li>- Power factor of each transformer</li> <li>- Electricity consumption at three billing periods (10pm-6am; 6am-5pm; 5pm-10pm): kWh / day</li> </ul>   | <ul style="list-style-type: none"> <li>Energy meter</li> <li>Power factor meter &amp; portable power analyzer</li> </ul>    |
| 9  | Accounting Section | <ul style="list-style-type: none"> <li>- Produced cement and cement sales</li> <li>- Cost allocation to sections</li> <li>- Capacity utilization</li> <li>- Remaining material stock report</li> <li>- Monthly balance sheet</li> <li>- Lime stone mined</li> <li>- Cost accounting report</li> <li>- Price change information</li> <li>- Annual report of production by unit (AU 7)</li> </ul> | <ul style="list-style-type: none"> <li>Economist</li> </ul>   |   | <ul style="list-style-type: none"> <li>Monthly</li> <li>Quarterly</li> <li>Yearly</li> </ul>    | <ul style="list-style-type: none"> <li>Economist-EREL corporate office</li> </ul>  | <ul style="list-style-type: none"> <li>- Specific electricity consumption (kWh) per tonne of clinker and cement</li> <li>- Specific coal consumption (kg) per tonne of clinker</li> </ul>   |   |