**Study partners**
Taiheiyo Cement Corporation  
Osumi Corporation  

**Project site**
Darkhan, Mongolia  

**Category of project**
Energy Conservation  

**Description of project**
Energy conservation and GHG emission reduction in Cement plant is to be achieved by introducing dry process instead of existing wet process.  

**JCM methodology**  

| Eligibility criteria | 1. Energy efficiency is secured by adopting dry suspension preheater or dry suspension preheater with precalciner. The plant capacity is 2,500t-clinker/day or more. Heat consumption shall be 900kcal/kg-clinker or less. Electricity consumption shall be 105kWh/t-cement or less.  
2. After conversion of process from wet to dry, unit CO2 emission within the current production capacity shall be lower by 35% or more than reference scenario.  
3. To evaluate by total performance, CO2 emission shall be lower 8% or more than that of Mongolian dry processes.  
4. Having sufficient performance for environment protection. To satisfy environmental regulatory standard and similar standard by installing ESP or bag filter.  
5. After operation, the facility can reduce energy loss with smooth and stable operation thanks to effective consideration for O&M. Annual operation days are expected above 300 days. |

**Default values**

| 1. CO2Emission factor for Coal | 101.2 t-CO2/TJ  
2006 IPCC Guidelines  
2. Grid electricity CO2 Emission factor | 1.1030t-CO2/MWh  
2009-2010 CDM-Mongolia Grid factor  
3. Unit heat value of coal | 4,200kcal/kg (17,581kJ/kg)  
Measured at the plant |

**Calculation of reference emissions**
Wet process unit energy consumption after operation improvement shall be used as reference unit energy consumption. Reference emission is calculated based on this unit energy consumption × production amount.  

**Monitoring method**
Coal consumption and cement production shall be measured certified weight scale per shipment. Monthly inventory is also used.  
Electricity consumption reading of certified transaction meter every month.  
Calorific value of fuel measured at plant for every shipment.  

**GHG emission reductions**
- Calculation of reference emission  
Reference emission = (Improved unit heat consumption of wet process(Gcal/t-clinker) × production volume (Clinker-t/d) × annual running days (d/y) × CO2emission
conversion factor from fuel \((CO_2\cdot t/Gcal)\) + improved unit electricity consumption of wet process \((Gcal/t-clinker)\) \times production volume \((Cement-t/d)\) \times annual running days \((d/y)\) \times CO_2 emission conversion factor from grid

Result 437,413 t-CO2/y

- Calculation of project emission

Project emission = unit heat consumption of dry process \((Gcal/t-clinker)\) \times production volume \((Clinker-t/d)\) \times annual running days \((d/y)\) \times CO_2 emission conversion factor from fuel \((CO_2\cdot t/Gcal)\) + improved unit electricity consumption of dry process \((Gcal/t-clinker)\) \times production volume \((Cement-t/d)\) \times annual running days \((d/y)\) \times CO_2 emission conversion factor from grid

Result 251,474 t-CO2/y

GHG emission reduction 185,939 t-CO2/y

<table>
<thead>
<tr>
<th>Environmental impacts</th>
<th>No environmental impact is expected since proposed process shall be equipped with ESP or bag filter.</th>
</tr>
</thead>
</table>
| Project plan          | 2014 Completion of feasibility and finance scheme  
                        Decision of studied plant, confirmation of finance scheme  
                        2015 Commencement of plant construction  
                        2017 Completion of plant construction, commissioning, and commercial operation. Commencement of recording  
                        2018~ Calculation of emission reduction |
| Promotion of Japanese technologies | Japanese technologies are superior in O&M and performance. However high cost prevents its dissemination. Chinese equipment is of competitive price. However, reliability is not enough. In this project, Chinese equipment with Japanese technology (supplied by implemented company’s JV) is considered for both price and reliability. |
| Sustainable development in host country | - Infrastructure development is essential in Mongolia to meet the recent economic growth.  
- However to meet increasing cement demand, using existing wet process may cause adverse effect to sustainable development of Mongolia with its high energy consumption, environmental impact.  
- Introduction of dry process, which is energy efficient, little environment impact, and possible for utilizing recycling waste like coal ash, contributes much for the sustainable development of Mongolia. |
JCM Feasibility Study (FS) 2013
“Energy Conservation in Cement Plant”
(Host country: Mongolia)

Study Entity:

1. Study Implementation Scheme
   (Japan)
   • Taiheiyo Engineering Corporation
     Main organizer, study and reporting
   • Taiheiyo Cement Corporation
     Arrangement for meeting host country government office and other organization Consideration of applicable finance scheme
   • Osumi Corporation
     Advice for methodology preparation, PDD preparation

   (Mongolia)
   • "BIZS-TEAM" Co., LTD
     Interpreter (Japanese – Mongol), arrangement of local transportation and accommodation.

2. Overview of Proposed JCM Project
   (1) Description of Project Contents:
   Energy conservation at EREL Cement Plant in Mongolia will be achieved by introducing dry process production system and other energy saving countermeasures. With the energy conservation, considerable amount of GHG emission can be reduced. GHG emission reduction is estimated 156,939t-CO2/year under the production volume of 500,000t-clinker/y and 525,000t/cement/y

   (2) Situations of Host Country:
   In Mongolia, most of the domestically produced cement is still manufactured with energy consuming wet process.
   To meet the increasing cement demand for the infrastructure development, cement production should be increased. However, with existing wet process, more GHG emission and environmental impact are big concern.
   In Mongolian NAMAs established in 2011, as one of the countermeasures in industrial sector, conversion of cement manufacturing process from wet to dry is included in item 8C. This shows this project meets the Mongolian climate change policy.
3. Study Contents  
(1) JCM methodology development  

a. Eligibility criteria

Eligibility criteria for this project were set as shown the table below. Basis for each criterion, especially the proposed technology is eligible for JCM project is also stated.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Description</th>
<th>Basis, reasons for appropriateness</th>
</tr>
</thead>
</table>
|Criterion 1 | Energy efficiency is secured with the following aspects;  
- Heat consumption shall be 900kcal/kg-clinker or less.  
- The plant which have capacity producing 2,500t-clinker/day or more.  
- Electricity consumption shall be 105kWh/t-cement or less | In dry process, comparing with existing wet process, necessary heat consumption (including heat to evaporate slurry moisture) decreases considerably. In Japan, no newly built project scale dry process, no published guideline for energy consumption. As an official reference, guideline from Chinese National Development and Reformation Committee exists. Figures shown on the left are set based on that guideline and local condition was also considered. |
|Criterion 2 | After conversion of process from wet to dry, unit CO₂ emission within the current production capacity shall be lower by 35% or more than reference scenario. | Normally, by converting wet process to dry process, heat consumption decreased about one half. For electricity consumption, same level of wet process or little increase because dry process has more equipment. Considering these points, it is assumed that at least 35% decrease can be achieved. |
|Criterion 3 | To evaluate by total performance, CO₂ emission shall be lower 8% or more than that of Mongolian 3 dry processes | If Japanese technology is adopted, energy loss between shutdowns and restarts can be minimized because of smooth operation thanks to Japanese O&M |
To evaluate individual countermeasure, that shall have advantage to the reference scenario of Mongolian 3 dry processes (This is similar to positive list and their effect proposed by Japan Cement Association proposed)

This is positive list policy, similar to the typical energy conservation technology proposed by Japanese Cement Association.

Criterion 4

Having sufficient performance for environment protection

To satisfy environmental regulatory standard and similar standard by installing ESP or bag filter.

Dust emission is observed from existing wet process manufacturing process because it is not equipped with efficient dust collector. Installation of ESP or bag filter is essential.

If regulatory standard or similar regulation exists, at least those standards must be cleared.

Criterion 5

The facility should be able to operate smoothly with consideration of O&M, and to reduce energy loss

Design and operation optimization can be achieved thanks to rich experience. High availability of equipment enables to minimize energy loss.

b. Data and parameters fixed ex ante

Data and parameters fixed ex ante to apply this project and their basis are shown hereunder.

<table>
<thead>
<tr>
<th>Data and parameters fixed ex ante</th>
<th>Figure</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion factor of CO2 from fuel</td>
<td>101.2 t-CO2/TJ</td>
<td>Figure shown on 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Page 1.23 Table 1.4 (Lignite 27.6tC/TJ) is converted to CO2. (C×44/12=CO2)</td>
</tr>
<tr>
<td>Conversion factor of CO2 from grid electricity</td>
<td>1.1030t-CO2/MWh</td>
<td>Shown on 2009-2010CDM-Mongolia Grid factor for Mongolian. Operating Margin (OM) 1.1501t-CO2/MWh Build Margin (BM) 1.0559t-CO2/MWh Combined Margin (CM, CM=(OM+BM)/2 ) is used for calculation.</td>
</tr>
<tr>
<td>Calorific value of coal</td>
<td>(4,200kcal/kg + 17,581kJ/kg) / 2 = 1.1030t-CO2/MWh</td>
<td></td>
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<tr>
<td>------------------------</td>
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</tr>
</tbody>
</table>

**c. Calculation of GHG emissions (including reference and project emissions)**

(1) Calculation of reference emission

1) Basis and reason for appropriateness of the calculated emission as reference

In this project, cement production volume will increase and will exceed current wet process production volume. Also, it should be noted that unit CO2 emission from wet process and from dry process differs a lot.

Therefore current (BaU) unit emission should not be used as reference because of too much emission reduction.

To calculate reference emission, method should be simple and conservativeness should be confirmed.

With consideration, the following scenario is set as reference scenario.

1) Reference unit energy consumption

Unit energy consumption of existing wet process after operation improvement is used for calculation of reference emission.

Plant study showed that there is still room for improvement of operation on existing wet process. It means that unit energy consumption can be lowered.

By estimating unit energy consumption after modification reference unit energy consumption can be set. Of course this unit energy consumption is lower than current situation (BaU), conservativeness is secured.

<table>
<thead>
<tr>
<th>BaU</th>
<th>After modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit heat consumption</td>
<td>2100 → 1,600 kcal/kg-clinker</td>
</tr>
<tr>
<td>Unit electricity consumption</td>
<td>170 → 170 kWh/t-cement</td>
</tr>
</tbody>
</table>

Reference emission is calculated with the following equation.

Reference emission = (Improved wet process unit heat consumption (Gcal/t-clinker) × Expected production capacity of dry process (clinker-t/day) × Annual operation day (day/y)) × CO2 emission factor from fuel (CO2-t/Gcal) + (Improved wet process unit electricity consumption (Gcal/t-cement) × Expected production capacity of dry process (t-cement /day) × Annual operation day (day/y)) × CO2 emission factor from grid electricity (CO2-t/MWh)
2) Calculation of reference emission

The following figures are used for calculation.

- Improved wet process unit heat consumption: 1,600 kcal/kg-clinker
- Improved wet process unit electricity consumption: 170 kWh/t-cement
- CO2 emission factor from fuel (IPCC Guideline 2006): 101.2 kg/GJ
- CO2 emission factor from grid electricity (CDM Mongolia Combined Margin): 1.1030 t/MWh
- Expected production capacity of dry process (clinker-t/day): 2,500 t-clinker/d
- Annual operation day: 200 days/y
- Expected annual cement production capacity of dry process: 525,000 t-cement/y

3) Result of calculation

**CO2 emission from fossil fuel consumption**

\[
\text{CO2 emission} = \frac{500,000 \times 1,600 \times 4.1868 \times 101.2}{1,000,000} = 338,971 \text{ t-CO2/y}
\]

**CO2 emission from grid electricity consumption**

\[
\text{CO2 emission} = \frac{262,500 \times 170 \times 1.1030}{1,000,000} = 98,442 \text{ t-CO2/y}
\]

Total CO2 emission: 437,413 t-CO2/y

Note: This emission is base for calculating emission reduction only, does not mean this amount is emitted.

Above results are calculated on the spreadsheet.

(2) Estimation of project emission

Project emission is calculated with the following equation.

\[
\text{Project emission} = (\text{Dry process unit heat consumption (Gcal/t-clinker)} \times \text{Expected production capacity of dry process (clinker-t/day)} \times \text{Annual operation day (day/y)}) \times \text{CO2 emission factor from fuel (CO2-t/Gcal)} + (\text{Dry process unit electricity consumption (Gcal/t-cement)} \times \text{Expected production capacity of dry process (t-cement/day)} \times \text{Annual operation day (day/y)}) \times \text{CO2 emission factor from grid electricity (CO2-t/MWh)}
\]

Reductions of unit energy consumption from wet to dry are shown below:

<table>
<thead>
<tr>
<th>Reduction of unit energy consumption</th>
<th>Improved wet</th>
<th>Proposed dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction of unit heat consumption</td>
<td>1600 kcal/kg-clinker</td>
<td>900 kcal/kg-clinker</td>
</tr>
<tr>
<td>Reduction of unit electricity consumption</td>
<td>170 kWh/t-cement</td>
<td>105 kWh/t-cement</td>
</tr>
</tbody>
</table>

Basis for above unit energy consumption is shown on attached Basis for eligibility
Calorific value of coal, emission factors are unchanged.

Result of calculation

**CO₂ emission from fossil fuel consumption**

\[
\text{500,000t-clinker/y} \times 900 \text{ kcal/kg-clinker} \times 4.1868 \text{ kJ/kcal} \times 101.2 \text{ kg CO₂/GJ} = 190,671 \text{ t-CO₂/y}
\]

**CO₂ emission from grid electricity consumption**

\[
\text{525,000t-cement/y} \times 105 \text{ kWh/t-cement} \div 1,000 \times 1.1030 \text{ t-CO₂/MWh} = 60,803 \text{ t-CO₂/y}
\]

Total CO₂ emission

251,474 t-CO₂/y

(3) Emission reduction

**CO₂ emission reduction from fossil fuel consumption**

\[
(1,600-900) \text{ kcal/kg-clinker} \times 500,000 \text{ t-clinker/y} \times 4.1868 \text{ kJ/kcal} \times 101.2 \text{ kg CO₂/GJ} \div 1,000,000 = 148,300 \text{ t-CO₂/y}
\]

**CO₂ emission reduction from grid electricity consumption**

\[
(170-105) \text{ kWh/t-cement} \times 525,000 \text{ t-cement/y} \times 1.1030 \text{ t-CO₂/MWh} \div 1,000 = 37,639 \text{ t-CO₂/y}
\]

Total CO₂ emission reduction

148,296 + 37,640 = 185,939 t-CO₂/y

(2) Development of JCM Project Design Document (PDD)

- Ty Necessary items for the preparation of PDD to register studied project to JCM (Necessity of EIA)
  
  It was found that Environment Impact Assessment (EIA) based on the EIA for existing plant facility.

- Identification of local stakeholder to be discussed and issues discussed with identified stakeholder.

  Studied plant identified that local stakeholder is Development Policy Department of Governor’s Office Darkhan Uul Aimag, where studied plant is located.

  As a local stakeholder needs to discuss, discussion with Chief of that section was held during the study.

  This project is conversion of manufacturing process, no change of stakeholder with implementation of project.
The following is the content of discussion.

Regarding the jurisdiction of approval of plant operation, audit section and construction section is in charge. However, final approval is issued from this Development Policy Department. During the discussion, the Chief conformed the following:

Difference between wet and dry system, installation of dust collector, and its performance.
→Explanation was made. Proposed dry process is equipped with dust collector, almost all dust will be collected.

Chief made a comment that Development Policy Department is highly interested in this project, appreciate for the improvement of environment impact mitigation.
Also, he stated that he will cooperate for the approval / license obtainment.

- Monitoring Plan (Including monitoring structure and keeping of obtained data)

It was confirmed that Environment Monitoring is regularly carried out by concerned department of local government. Record is kept at the plant.

- Calibration of measuring equipment

In Studied production process, weighing devises for raw material, fuel and product is used. Also, transaction electricity meter is used to measure consumed electricity.
These equipment are regularly (every 6 months) calibrated by Mongolian Department of Standard and Metrology.
The result of calibration and certification should be kept with weighing record.

(3) Project development and implementation

a. Project planning

Arrangement and negotiation for the implementation of project from next year

- With the advice from Ministry of Environment and Green Development, to make project cost feasible, adopting equipment using Japanese technology made in other countries is considered.

- For financial scheme, applicable soft loan scheme is considered. Conditions like lower limit of Japanese made equipment ratio are being studied in applying Finance from Japan,
Project schedule is shown below;

2014  Completion of feasibility and finance scheme  
      Decision of studied plant, confirmation of finance scheme
2015  Commencement of plant construction
2017  Completion of plant construction, commissioning, and commercial operation.  
      Commencement of recording
2018〜 Calculation of emission reduction

b. MRV structure

- Confirmation situation with studied plant regarding MRV structure in project implementation stage
- Through two times of plant study, it was found that necessary parameters are measured and recorded. For measuring devises, calibration and certification by Mongolian Department of Standard and Metrology. Therefore, reliability of measured values is secured.  
  ♠ On the other hand, it was found that improvement in recording is necessary. Countermeasures and guidelines shall be shown on the report.

- Expected MRV structure  
  ♠ MRV structure is shown below. MRV is carried out mainly by Taiheiyo Engineering, with the cooperation/advice of Taiheiyo Cement Corporation, and Osumi Corporation.

MRV structure

- Permission and authorization for the project implementation

  - Necessary approval / license to implement project  
    ➢ As stated previously in the stakeholders, regarding the jurisdiction of approval of plant operation, audit section and construction section is in charge. However, final approval is issued from this Development Policy Department

  - Expected time of approval / license obtainment

  - Development Policy Department of Governor’s Office Darkhan Uul Aimag, is local stakeholder and approval holder. Since he is supportive to the project, it will not take time to obtain approval / license.
● Approval for trade
  ➢ Import of project equipment is expected to be duty free. However, study for the case of import equipment using Japanese technology made in other countries is made.

d. Japan’s contribution

● Conditions for introducing Japanese technologies are as follows:

  ● Acceptable equipment cost
    ➢ Equipment exported from Japan will be of high cost and it is big challenge for implementation. Adoption of equipment using Japanese technology made in other countries is being considered.

  ● Favorable finance scheme
    ➢ From Japan International Cooperation Association, financial support activity especially STEP (Special Terms for Economic Partnership) is considered.
    ➢ From Japan Bank of International Cooperation, schemes like export finance is considered.

e. Environmental integrity

● Japanese GHG emission reduction technology to be introduced to this project is at the same time closely related to environment protection. Environment impact to surrounding area can be considerably minimized.
  (Dust emission was observed from existing wet process. This may be an environmental issue in the future.)

● By taking account this point, it is possible to consider favorable treatment for dissemination of Japanese GHG emission reduction technology. For example, JCM support for project financial scheme, application of ODA fund. In applying such scheme, certain necessary level for energy efficiency and dust emission should be set.

● With this scheme, both sides achieve the following advantages;
  ➢ Mongolia: securing environment integrity, energy conservation
  ➢ Japanese equipment manufacturer: derivation of GHG emission reduction technology
  ➢ Japan and Mongolia; JCM credit in the future

f. Sustainable development in host country

● Infrastructure development is essential in Mongolia to meet the recent economic growth.
● However to meet increasing cement demand, using existing wet process may cause adverse
effect to sustainable development of Mongolia with its high energy consumption, environmental impact.

- Introduction of dry process, which is energy efficient, little environment impact, and possible for utilizing recycling waste like coal ash, contributes much for the sustainable development of Mongolia.

g. Toward project realization (planned schedule and possible obstacles to be overcome)

- Selection of equipment considering local condition
  Cost estimation is underway. Equipment cost is already estimated. For installation and other cost, estimation is underway. Total cost is estimated later.

- Necessary approval / license
  Confirm necessary approvals / licenses other than from stakeholder and their procedure for obtainment.

- Finance scheme
  Consideration of applicable financial scheme is being made.

(End of summary)