「Regenerative burners for aluminum melting furnaces」

(implemented by Toyotsu Machinery Corporation)

<table>
<thead>
<tr>
<th>Study partners</th>
<th>Mizuho Bank, Ltd.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PT.TOYOTA TSUSHO INDONESIA</td>
</tr>
<tr>
<td>Project site</td>
<td>Indonesia; Jakarta</td>
</tr>
<tr>
<td>Category of project</td>
<td>Energy Efficiency Improvement</td>
</tr>
<tr>
<td>Description of project</td>
<td>In the proposed project, we plan to install “Regenerative Burner” that has ability to generate the heat for aluminum furnaces as the replacement of the conventional burners installed in the automotive components manufacturer in Indonesia, in order to reduce fossil fuel consumption and CO₂ reduction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>JCM methodology</th>
<th>Eligibility criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. The furnace is either of the following types for the aluminum casting process:</td>
</tr>
<tr>
<td></td>
<td>・ Melting furnace</td>
</tr>
<tr>
<td></td>
<td>・ Holding furnace</td>
</tr>
<tr>
<td></td>
<td>2. Project type is either Greenfield, expansion of the existing facility or replacement of the existing facility.</td>
</tr>
<tr>
<td></td>
<td>3. Electricity used in the project activity is purchased from the Java-Bali Grid.</td>
</tr>
<tr>
<td></td>
<td>4. Regenerative burner is applied to the furnace under the project activity.</td>
</tr>
<tr>
<td></td>
<td>5. The manufacturer of the furnace or the burner has constructed the maintenance system before introducing the regenerative burner including the followings:</td>
</tr>
<tr>
<td></td>
<td>・ It has a district factory of facility manufacturing or a district office of facility supply.</td>
</tr>
<tr>
<td></td>
<td>・ It makes a maintenance contract (maintenance against malfunction and parts supply) with the user of the facility.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Default values</th>
<th>1. CO₂ emission factor of the Java-Bali grid in year 2010, ex-ante</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.741tCO₂/MWh</td>
</tr>
<tr>
<td></td>
<td>2. Energy consumption intensity used for each type of industrial furnace is shown below (default value).</td>
</tr>
<tr>
<td></td>
<td>・ Melting furnace: 870,000 kcal/Ton</td>
</tr>
<tr>
<td></td>
<td>・ Holding furnace: 93 kcal/kg*h</td>
</tr>
<tr>
<td></td>
<td>3. Use IPCC data for calorific value of natural gas and CO₂ emission factor of natural gas according to the kind of fuel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculation of reference emissions</th>
<th>CO₂ emissions are calculated based on the estimated consumption of fossil fuel in the assumed facility to be introduced without the proposed project.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Got sampling data of the candidate company plants, screened</td>
</tr>
</tbody>
</table>
on work road to the capacity, determined the best value as the reference.

| Monitoring method                   | - Consumption of fossil fuel (natural gas): Monthly  
|                                    | - Consumption of electricity: Monthly            
|                                    | - Material weight for melting: Each time and total of month  
|                                    | - Holding time of the holding furnace: Monthly    |
| GHG emission reductions            | Reference CO$_2$ emissions is calculated under the assumption of energy consumption intensity of the furnace without the project activity, which is decided for each type of melting furnace and holding furnace, the same type and the same manufacturing output with the project activity to introduce the regenerative burner. Estimated Emission Reductions: 1,622 (tCO$_2$) / Year at the project site. |
| Environmental impacts              | This project gives no increase of environmental effect. |
| Project and its financial plan     | Replace one melting furnace with capacity 1,500 kg/h and 13 holding furnaces for the motorcycle manufacturer. Financial study by cash flow analysis shows IRR 26.45% with 50% subsidy for initial investment. |
| Promotion of Japanese technologies| Regenerative burner of Japan is developed in the 1990s, and has advantage over the overseas products in low NOx and high efficiency. Japanese manufacturer has outlets in Jakarta area and gives support to the customer. Bloom engineering, world giant in the burner, has no outlet in Jakarta area. Asian manufacture sell low cost regenerative burner, 20% of the Japanese burner in cost, but the product has problem in reliability and durability. Japanese regenerative burner will be applied to the melting furnace and holding furnace under the project activity. |
| Sustainable development in host country | Energy consumption in Indonesia is increasing year by year, and energy saving Regenerative burner technique will help sustainable development. Regenerative burner will apply to iron heating and heat treatment furnace more effectively than for nonferrous furnace because of high temperature usage. |
JCM Project Planning Study (PS) 2013

“Regenerative burners for aluminum melting furnaces”
(Host country: INDONESIA)

Study Entity: Toyotsu machinery Corporation

1. Study Implementation Scheme
   Mizuho Bank, Ltd.; Advice on JCM methodology and study financial plan
   PT. TOYOTA TSUSHO INDONESIA; Support arrangement with manufacturer
   in Jakarta and help general affairs

2. Overview of Proposed JCM Project
(1) Description of Project Contents:
   In the proposed project, we plan to install “Regenerative Burner” that has ability to generate the
   heat for aluminum furnaces as the replacement of the conventional burners installed in the automotive
   components manufacturer in Indonesia, in order to reduce fossil fuel consumption and CO₂ reduction.

(2) Situations of Host Country:
   Almost of all automotive components manufacturer in the Jakarta area operate aluminum melting
   furnace and holding furnace with conventional burner.

3. Study Contents
(1) JCM methodology development
   a. Eligibility criteria
      1. The furnace is used in the aluminum melting process before casting.
      2. The furnace is either of the following types:
         • Melting furnace
         • Holding furnace
      3. Project type is either Greenfield, expansion of the existing facility or replacement of the existing
         facility.
      4. Electricity used in the project activity is purchased from the Java-Bali Grid.
      5. Regenerative burner is applied to the furnace under the project activity.
      6. The manufacturer of the furnace or the burner has constructed the maintenance system before
         introducing the regenerative burner including the followings:
         • It has a district factory of facility manufacturing or a district office of facility supply.
         • It makes a maintenance contract (maintenance against malfunction and parts supply) with the
           user of the facility.
7. **b. Data and parameters fixed ex ante**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description of data</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{EF}_{\text{e},y}$</td>
<td>CO2 emission factor of the Java-Bali grid in year $y$ [tCO2/MWh]</td>
<td>The government of Indonesia</td>
</tr>
<tr>
<td>$\text{NCV}_{\text{NG},y}$</td>
<td>Calorific value of natural gas [GJ/t]</td>
<td>IPCC</td>
</tr>
<tr>
<td>$\text{EF}_{\text{NG},y}$</td>
<td>CO2 emission factor of natural gas [tCO2/GJ]</td>
<td>IPCC</td>
</tr>
<tr>
<td>$\text{RFC}_{\text{m},y}$</td>
<td>Energy consumption intensity of natural gas in the melting furnace (reference) = $87 \times 10^4$ [kcal/t]</td>
<td>Market research</td>
</tr>
<tr>
<td>$\text{RFC}_{\text{h},y}$</td>
<td>Energy consumption intensity of natural gas in the holding furnace (reference) = 93 [kcal/kg·h]</td>
<td>Market research</td>
</tr>
</tbody>
</table>

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

**Reference emissions calculation**

Reference emissions are decided by energy consumption intensity of the melting furnace and holding furnace.

Reference emission

$\text{RE}_y = \text{Energy consumption intensity (Reference)} \times \text{CO}_2 \text{ emission factor} \times \text{Melting weight (Project)}$

We got sample data from the manufacturer and calculate as follows. Sampling data are screened as delete low load operation furnace. The best data assumed as *reference*.

- **Melting furnace**
  - Get melting weight (ton) and fuel consumption (L. t), and calculate intensity $\text{kcal/ton}$ with calorific value.
- **Holding furnace**
  - Get average holding weight (kg), holding hours and fuel consumption (L. t) and calculate intensity $\text{kcal/kg·h}$ with calorific value.

$\text{RE}_e = \text{RE}_e + \text{RE}_f$

Where:

$\text{RE}_y$ Reference CO2 emissions in year $y$ [tCO2/y]
$\text{RE}_e$ Reference CO2 emissions in year $y$ (from electricity) [tCO2/y]
$\text{RE}_f$ Reference CO2 emissions in year $y$ (from fossil fuel) [tCO2/y]

$\text{RE}_e = 0$
Where:
RE = Reference CO2 emissions in year y (from electricity) [tCO2/y]

< Melting furnace >
Where:
RE, = Reference CO2 emissions in year y (from fossil fuel) [tCO2/y]
RFC, = Energy consumption intensity of natural gas (reference) [kcal/t]
EFng, = CO2 emission factor of natural gas [tCO2/GJ]
PM, = Material weight for melting in year y [t/y]

< Holding furnace >
Where:
REh, = Reference CO2 emissions in year y (from fossil fuel) [tCO2/y]
RFCh, = Energy consumption intensity of natural gas (reference) [kcal/kg h]
EFng, = CO2 emission factor of natural gas [tCO2/GJ]
PMh, = Average aluminum molten metal weight in the holding furnace [kg]
Th, = Holding hours of molten aluminum of the holding furnace in year [h/y]

Project emissions calculation

PEy = PEe + PEf
Where:
PEy = Project CO2 emissions in year y [tCO2/y]
PEe = Project CO2 emissions in year y (from electricity) [tCO2/y]
PEf = Project CO2 emissions in year y (from fossil fuel) [tCO2/y]

PEe = ELy * EFy
Where:
PEe = Project CO2 emissions in year y (from electricity) [tCO2/y]
ELy = Consumption of electricity (project) [MWh/y]
EFy = CO2 emission factor of the Java-Bali Grid [tCO2/MWh]

PEf = PFCy * NCVng, * EFng, y
Where:
PEf = Project CO2 emissions in year y (from fossil fuel) [tCO2/y]
PFCy = Consumption of natural gas (project) [t/y]
NCVng, = Net Calorific Value (NCV) of natural gas [GJ/t]
EFng, = CO2 emission factor of natural gas [tCO2/GJ]
Emissions reductions

\[ ER_y = RE_y - PE_y \]

Where:
- \( ER_y \): CO2 reduction in year \( y \) [tCO2/y]
- \( RE_y \): Reference CO2 emissions in year \( y \) [tCO2/y]
- \( PE_y \): Project CO2 emissions in year \( y \) [tCO2/y]

The project of replacement of one 1,500 kg immersion type melting furnace and 13 crucible holding furnaces will reduce 1,622 tCO\(_2\) per year, 32% reduction.

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

There are many kind of furnace and regenerative burner is not almighty for all the type of the furnace. We studied many automotive parts manufacturer in the Jakarta area, and discuss with furnace manufacturer and burner manufacturer, too. Our plan is to apply regenerative burner for the following type of furnace.

1) Melting furnace: Melting capacity 1,500 kg/Hr
   - Immersion type melting furnace which has melting and holding bath with regenerative burner.
2) Holding furnace: Holding capacity 1,000 kg
   - Crucible type holding furnace with “Self” regenerative burner which burns right and left flow flame alternatively.

(3) Project development and implementation

a. Project planning

We agree with one of the Japanese motorcycle manufacturer to replace their Meting furnace and Crucible holding furnaces. See Project schedule in section “G”

b. MRV structure

The proposed project is use the burner manufacturer which has a district office of facility supply and preparing for the contract for maintenance against malfunction and parts supply.

c. Permission and authorization for the project implementation

It is confirmed no need of permission by authority on installation of industrial furnace. And also no need in case of equipment import from Japan.
Regarding this JCM project, it seemed to be approved by Joint committee organized Indonesia and Japanese government. We heard DNPI will lead organization settlement the Joint committee.

d. Japan’s contribution

Japanese burner manufacturer developed Low NO\textsubscript{X} and high efficiency regenerative burner better than other country. Japanese smelter in Jakarta area have already install regenerative burner for their furnace, but local smelter use conventional burner even a newly installed furnace. One of the local smelter who installed regenerative burner which is not made in Japan, but it is not work because of frequent trouble. Popularization of Japanese regenerative burner will get off suspicion on regenerative burner in the local market.

One of the big western burner manufacturer, Bloom engineering has a series of regenerative burner same as Cyugairo, Japanese top burner supplier, and seems high level quality regenerative burner like low NO\textsubscript{X} under 70 ppm and 150 ppm series as same as Cyugairo. But Bloom engineering has no base in Indonesia, only China in Asia.

e. Environmental integrity

This project gives no increase of environmental effect

f. Sustainable development in host country

Energy consumption in Indonesia is increasing year by year, and energy saving regenerative burner technique will help sustainable development. Regenerative burner will apply to iron heating and heat treatment furnace more effectively than for aluminum because of high temperature treatment.
g. Toward project realization (planned schedule and possible obstacles to be overcome)

The project schedule is as follows:

<table>
<thead>
<tr>
<th>Task</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feb</td>
<td>Mar</td>
</tr>
<tr>
<td>1 Consortium agreement JCM Project request</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Design/ Manufacturing/ Installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Build Maintenance and Support system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Study Standardized specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Popularization activity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The task we should solve is cost reduction of regenerative burner especially for the holding furnace. Burner cost percentage is very big on the total furnace cost of holding crucible furnace. Cost reduction is planned to design Indonesian common specification through the market and produce a large lot manufacturing.