CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Proposed methodology title:

Reduction in the use of Ordinary Portland Cement for concrete mix preparation.

A.2. List of category(ies) of project activity to which the methodology may apply:

The project activity is applicable to 'Category 6 that relates to construction industry'. In the absence of an appropriate project sub-category definition, a new project sub-category has been considered titled *"substitution of GHG intensive materials in concrete mix preparation"*.

A.3. Conditions under which the methodology is applicable to CDM project activities:

The conditions under which this project activity would be applicable include the following:

1. project activity involves reduction in ordinary portland cement (OPC) use for the preparation of concrete mix in a variety of construction applications, by substituting part of OPC content in concrete mix with alternate materials of less GHG intensity;

2. there are no existing regulations/ legislation that encourage or prohibit the reduction in OPC content in concrete mix preparation;

3. the project activity do not directly control baseline emission, project emission or emission reduction in OPC production process; it results in reduction of OPC requirement in concrete mix preparation and hence indirectly results in avoiding the need to produce more OPC in the cement industry, thereby avoiding CO_2 emissions from OPC manufacturing processes; and

4. the concrete mix prepared by the project activity should not adversely impact the functionality and is in compliance with applicable standards/ guidelines etc., on the functional characteristics of concrete mix.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

Potential Strengths

1. The methodology ensures a conservative baseline by considering only carbon dioxide (CO_2) emissions during production of the OPC.

2. The methodology is cost effective in its application since the actual project data archived during the planning and execution of a construction project can be used for calculating reduction in OPC usage and consequent emission reductions.

Potential Weakness

1. The methodology cannot distinguish quantum of CO_2 emissions from different OPC production processes/ technologies.

2. The methodology cannot provide a check on actual avoidance of OPC production by a quantity (at the margin) equal to its actual reduction.

3. The methodology neither monitors CO_2 emissions at individual cement manufacturing units nor directly causes CO_2 emission reduction in cement production process.

SECTION B. Overall summary description:

In the preparation of concrete mix for use in various construction applications, OPC is used as a major component. The quantity of OPC to be used in any grade and application is pre-determined based on defined and accepted standards and guidelines, and has defined ratios with respect to water content in the concrete mix.

Lower cement concrete technology (LCCT), used in the project activity to which this methodology is applicable, is based on the following two approaches:

1. use of high range water reducing admixtures to decrease the OPC content in concrete mix, and

2. decrease the OPC content in the concrete mix through its partial replacement with alternate cementitious materials like fly ash or slag.

The LCCT could help in reducing the water and cement requirements in the concrete mix though not reducing the water to cement ratio in the mix.

The project activity combines both these approaches mentioned above.

The savings in use of OPC in concrete mix preparation, would avoid production of OPC by that amount, thus, avoiding emission of GHGs to produce the quantum of avoided OPC in the concrete mix.

Accordingly, the project activity involves *"reduction in the use of OPC for concrete mix preparation"*.

The baseline methodology has two components:

1. determination of quantum of OPC used to prepare one tonne of concrete mix in the absence of the project activity; and

2. determination of GHG emissions for a tonne of OPC produced in the cement industry.

Using 1 and 2, the GHG emissions in the preparation of one tonne of concrete, attributable to OPC content in concrete mix can be computed.

The methodology suggests the use of CO_2 emission factor data from National Communications of the host country for emissions due to clinker production process in OPC manufacturing, and use any authoritative national level sector-wise average for CO_2 emission due to use of fuels in OPC manufacturing process or calculate the same using plant-wise fuel consumption data and IPPC data on emissions for different fuels, for computation of 2 as mentioned above.

The emissions from the project activity attributable to the manufacturing of substituting material can be taken to be zero, if the substituting material is a waste material which otherwise would have been disposed. Otherwise, GHG emissions in production of that substituting material, from gate to gate part of the life cycle, would determine the emissions from the project activity.

The emissions due to transportation of raw materials and concrete mix preparation are included in leakage calculations.

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SECTION C. Choice of and justification as to why one of the baseline approaches listed in paragraph 48 of CDM modalities and procedures is considered to be the most appropriate:

C.1. General baseline approach:

- **Existing actual or historical emissions, as applicable;**

- Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

- The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

C.2. Justification of why the approach chosen in C.1 above is considered the most appropriate:

The chosen baseline methodology is in line with the approach marked (highlighted) under section C.1, foreseen in the Marrakech Accords. "Existing actual or historical emission, as applicable", are based on the emission data of the existing OPC manufacturers in the host country and the OPC that is to be used in preparation of the concrete for a specific application as per the applicable standards/ guidelines followed in the host country or tender documents applicable to a project activity.

The other two approaches mentioned under section C.1 are not suitable because:

The second approach –"*Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment"* requires determination of economically attractive options and in situations where the markets are distorted and/ or the availability of data is doubtful, the application in specific Annex I country contexts will be restrictive.

The third approach *"the average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category"* is not applicable as the activities similar to project activities have not occurred in many Annex I countries, and hence application of this approach will be restrictive.

SECTION D. Explanation and justification of the proposed new baseline methodology:

D.1. Explanation of how the methodology determines the baseline scenario (that is, indicate the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity):

In the absence of the project activity, the preparation of concrete mix in construction activities in varied applications would have proceeded with the use of OPC in such quantum as prescribed under the following requirements:

1. existing national and/or specific guidelines/standards/protocols for concrete mix preparation that define the OPC usage quantum in concrete mixes for specific applications; and

2. in the absence of any such applicable standard to a specific application of concrete mix, construction project's tender document specifications on quantum of OPC to be used in concrete mix preparation.

Thus, in the absence of the project activity, OPC would have been used for concrete mix production as per prescribed requirements mentioned above.

The project activity results in reducing the use of OPC (quantum as above) without causing any negative impacts on the application or concrete mix quality and functionality and hence avoids production of such quantum of OPC.

In the absence of the project activity, such quantum of OPC would have been produced and thus generating the GHG emissions- quantum of which is a product of quantity of OPC substituted by the project activity and CO_2 emissions in manufacturing of one unit of OPC.

Hence, emissions in the baseline are computed as:

(Quantum of OPC that would have been used in the baseline scenario) * (CO_2 emission factor calculated for OPC production in the host country).

D.2. Criteria used in developing the proposed baseline methodology:

The criteria to determine how much OPC would have been used in concrete mix for a specific application, the methodology proposes to use:

- existing national and/or specific guidelines/ standards/ protocols for concrete mix preparation that define the OPC usage quantum in concrete mixes for specific application;

- and in the absence of any such applicable standard to a specific application of concrete mix, construction project's tender document specifications on quantum of OPC to be used in concrete mix preparation.

To estimate the CO_2 emissions for manufacturing of one unit of OPC, the methodology proposes to use the average specific emission from four nearest cement plants to the construction site identified in the project boundary. However, as such estimation is ex-post, an ex-ante calculation using official data from Host Country sources is recommended to arrive at initial (ex-ante) estimates of the baseline.

D.3. Explanation of how, through the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario (section B.3 of the CDM-PDD):

The demonstration of the additionality for any project activity has been based on the "Annex 1 - Tool for the demonstration and assessment of additionality[1]". The additionality check should be completed as per steps mentioned below.

Step 0 Preliminary screening of projects started after 1 January 2000 and before 31 December 2005.

If the project has been initiated within the period mentioned above, evidence should be provided to the DOE that the CDM incentive was seriously considered in the decision to proceed with the project activity. Such evidence should be based on (preferably official) documentation showing that the CDM incentive played a role in the decision-making process. If such evidence is not available then the project is not additional, else proceed to step 1.

Step 1 Demonstrating that the project activity is not mandated under current laws and regulations.

The project activity needs to demonstrate that its implementation is not a requirement under the existing laws and regulations either for the construction industry sector or as a part of

[1] CDM EB 16 Report.

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environmental legislation in the country or region of its application. If any such legal requirement exists then the project activity is not additional.

If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with all regulatory requirements, then the proposed CDM project activity is not additional.

At this stage, if the project is found not to be 'not-additional', then proceed to step 2 or to step 3, or to both steps 2 and 3.

Step 2 Investment Analysis.

An investment comparison analysis using a financial indicator (such as IRR or cost-comparison, etc.) could be applied to check whether there is at least one identified alternative that is better for investment than the project activity.

If there is at least one alternative to the project activity that is in compliance with all regulations and standards, that is financially more attractive then the proceed further to step 4, otherwise to step 3.

Step 3 Barrier Analysis

The barrier analysis could follow after either step 2 or step 3, and should consider one or more of the following:

Investment:	Investors to this project activity (management) may perceive risks to their investment due to unfamiliarity with the new technology, and risks to investments on research and development R&D activities, training, marketing, equipment procurement and actual procurement of replacement materials. There could be reduction in returns from the project since some clients could insist on paying on the basis of actual quantity of OPC used, and not on the basis of quantity of concrete mix used. The CDM revenues could be used to overcome such barriers to investment.
Technological:	The new technology could be developed in-house by the project sponsor or procured in collaboration with a technology partner; the reliability of the technology to provide similar results as provided by normal use of OPC in the baseline scenario needs to be established to overcome the technological barrier, through an established QA/QC programme.
Prevalence:	The project activity in its nature and scale of application could be one of the first of such projects on which the project proponent may not have familiarity; the project activity should demonstrate that such drawback is overcome by providing appropriate training to labour and step-wise increase in scale and extent of application. The project activity should be analysed with respect to its extent of implementation in similar applications and sectors where the baseline scenario is a common and normal course of practice.
Other Barriers:	Other users of the alternative material such as cement or brick manufacturers

	may object to the diversion of fly ash or slag for concrete mix preparation; there could be resistance from clients for allowing reduction in use of OPC in their projects; such barriers need to be overcome through conducting stakeholder awareness programmes.

The above barriers may prevent the project sponsor from undertaking the project activity, if there is no sufficient incentive to overcome these barriers and make the project happen. If the project activity does not face any of the above barriers, then the project activity is not additional. If the project activity is found not to be 'not-additional' then proceed to step 4.

Step 4 Common Practice Analysis

An analysis should be provided to show that in the country or region where the project activity would be performed, no other similar concrete mix production activity resulting in reduction of OPC has occurred at similar or larger scale, without the CDM revenue.

If such an analysis demonstrates that many similar activities were undertaken without CDM revenues, then the project is not additional; otherwise proceed to step 5.

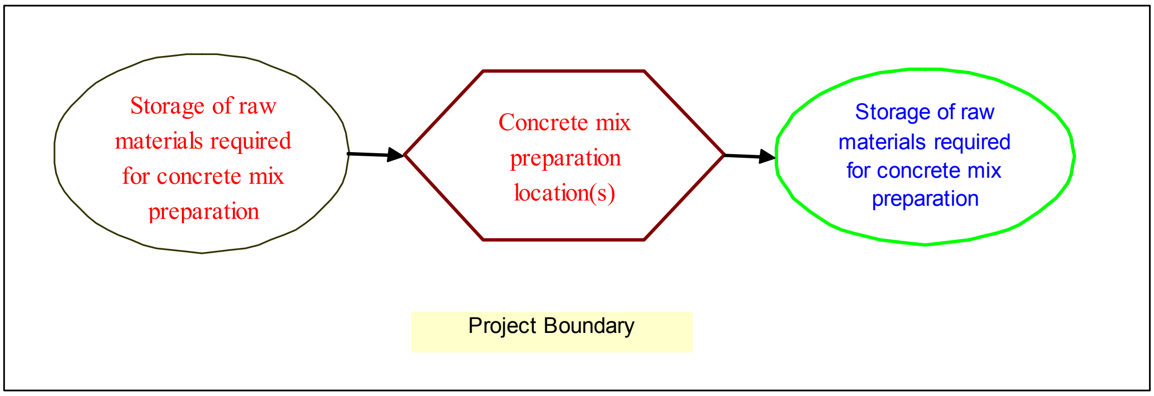
Step 5 Impact of CDM Registration

It should be demonstrated that the CDM registration has potential to promote and encourage construction company(ies) to implement such practices in their operations. If it is demonstrated than the project activity is additional, otherwise not.

D.4. How national and/or sectoral policies and circumstances can been taken into account by the methodology:

The boundary of the project activity is the concrete mix production activity at one location or more locations as the case may be. The storage of raw materials required for concrete mix preparation (one step up-steam activity) and storage of concrete mix (one step down-steam activity) before use are also included in the project boundary.

The transportation of raw material and concrete mix, and manufacture/ generation of OPC and alternative materials are not included in the project boundary.



D.5. Project boundary (gases and sources included, physical delineation):

The project participant through the project activity is not expected to have any direct control over the anthropogenic emissions of CO_2 from OPC manufacturing plants. However, the project participant undertakes a project activity that results in reasonably attributable avoidance of CO_2 emissions at sources of such emissions (OPC production plants) in significant measures based on the extent of OPC use avoided due to the implementation of the project activity.

Hence, the project activity will identify locations of concrete mix preparation plants for identified/ associated construction projects. The baseline usage of OPC and actual use of the same in the project activity at each such location will be recorded.

The project boundary will not include any OPC manufacturing plant or direct monitoring of their CO_2 emissions, material and fuel use, and production quantity produced.

D.6. Elaborate and justify formulae/algorithms used to determine the baseline scenario. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

The total quantity of OPC that would have been used in the baseline scenario ($\mathbf{PB_Y}$) avoided due to the project activity is determined from the project proponent's target to avoid OPC use in concrete mix preparation, as per the following formulae:

$$PB_{C,G,Y} = BC_{C,G,Y} * V_{C,G,Y} \quad \ldots\ldots (1)$$

where:

$BC_{C,G,Y}$ = Proportion of OPC in unit volume of concrete mix *(in tonnes/ cubic meters)* in application 'G' during year 'Y' at 'C' concrete mix preparation location,

$V_{C,G,Y}$ = Gross volume of concrete produced for use *(in cubic meters)* in application 'G' during year 'Y', at 'C' concrete mix preparation location and

G = Number of grades of concrete mixes used at the concrete mix preparation location 'C' during year 'Y'.

The total quantity of OPC that would have been used for all grades of concrete mixes to be used (G = 1, 2, ……) across several applications at concrete mix preparation location 'C' during year 'Y' will be calculated by adding the individual usages in several grades:

$$PB_{C,Y} = \Sigma\, PB_{C,G,Y} \quad \ldots\ldots (2)$$

Estimation of CO_2 Emission Factor (ex – ante) due to OPC production

For calculating the emission factor ($\mathbf{EF_{PC}}$) for ex-ante estimation of baseline emissions, publicly available data on the same from any national level authority could be used. The same needs to be updated ex-post for each crediting year of the project activity.

Estimation of CO_2 Emission Factor (ex – post) due to OPC production

The emission factor ($\mathbf{EF_{PC}}$) for OPC manufacturing has been calculated using process related CO_2 emissions from production of clinkers and use of fuels for energy in the total OPC manufacturing process. For each concrete mix preparation location to be identified in the project boundary, a maximum of 4 nearest located OPC producing plants will be identified for sourcing. The emission factor relevant to each concrete mix preparation location will be calculated as average emission factor for the corresponding OPC producing plants. The same procedure will be repeated for all concrete mix preparation plants identified in the project boundary.

The CO_2 emission factor ($\mathbf{EF_{clinker}}$) for clinker production could be used from any publicly available National level database such as National Communications by the Host Country, etc.

The CO_2 emission factor ($\mathbf{EF_{fuel}}$) due to use of fuels in OPC manufacturing process could be used from any authoritative national level sector-wise average for CO_2 emission due to use of fuels in OPC

manufacturing process or calculate the same using plant-wise[2] fuel consumption data and IPPC data on emissions for different fuels. If calculated plant-wise, the following algorithm will be used.

$$\mathbf{EF_{fuel} = \sum (Q_{fuel} * NCV_{fuel} * CEF_{fuel} * COF_{fuel} * 44/12) / \sum (Q_{OPC})} \text{ ....(3)}$$

where:

EF_{fuel} =	CO_2 emission factor for any OPC producing plant during a year prior to start of project activity crediting period (tCO_2/ tonne of OPC produced)
Q_{fuel} =	Annual quantity of fuel used in the corresponding OPC producing plant (mentioned above) during a year prior to start of project activity crediting period (tonnes)
Q_{OPC} =	Annual quantity of OPC produced in the corresponding OPC producing plant (mentioned above) during a year prior to start of project activity crediting period (tonnes)
NCV_{fuel} =	Net calorific value for fuel used as above as per IPCC (TJ/ 10^3 tonnes of fuel used)
CEF_{fuel} =	Carbon emission factor for fuel used as above as per IPCC (tonnes C/ TJ)
COF_{fuel} =	Carbon oxidation factor for fuel used as above as per IPCC.

Hence, the CO_2 emission factor (**EF_{PC}**) is calculated as:

$$\mathbf{EF_{PC} = EF_{clinker} + EF_{fuel}} \text{.......................(4)}$$

Estimation of CO_2 Emissions avoided due to avoided OPC (of quantum PB_Y) manufacturing

Using EF_{PC} *(in tonnes CO_2 emitted per tonne of OPC produced)*, the annual baseline emission (BL_{PC} *in tonnes*) of CO_2 is calculated as, using summation for all concrete mix preparation location considered within the project boundary:

$$\mathbf{BL_{PC} = \sum (EF_{PC} * PB_{C,Y})} \text{ ....(5)}$$

D.7. Elaborate and justify formulae/algorithms used to determine the emissions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

The reduction of use of OPC through the new technology could be effected under the project activity through the first stage or second stage or first stage followed by second stage, as described below.

Stage 1: Adding a high range water reducing admixture to the concrete mix thereby reducing the requirement of OPC; and/or

Stage 2: Using alternate cementitious materials to partially replace the balance requirement of OPC in the concrete mix.

For step 1 (wherein only admixture is used in the concrete mix), the requirement for OPC ($PA_{Ci,G,Y}$ *in tonnes*) at concrete mix preparation location 'Ci' for concrete mix grade 'G' during year 'Y', will be calculated as follows:

$$\mathbf{PA_{Ci,G,Y} = RA_{Ci,G,Y} * RV_{Ci,G,Y}} \text{..(6)}$$

where:

[2] For maximum of nearest 4 OPC manufacturing plants that would supply OPC to a concrete mix preparation location considered within the project boundary.

$RA_{Ci,G,Y}$ = Reduced proportion of OPC in unit volume of concrete mix *(in tonnes/ cubic meters)* in application 'G' during year 'Y',
$RV_{Ci,G,Y}$ = Gross volume of concrete produced for use *(in cubic meters)* in application 'G' during year 'Y', and
G = Various grades of concrete mixes used at site 'Ci' during year 'Y'.

The total quantity of OPC that would have been used for all grades of concrete mixes to be used (G = 1, 2, ……) across several applications at concrete mix preparation location 'Ci' during year 'Y' will be calculated by adding the individual usages in several grades:

$$PA_{Ci,Y} = \Sigma\ PA_{Ci,G,Y} \quad \text{...(7)}$$

For step 2 (wherein both admixture and alternate cementitious material are added in the concrete mix), the requirement for OPC ($PAA_{Cj,G,Y}$ *in tonnes*) at concrete mix preparation location 'Cj' for concrete mix grade 'G' in which admixture has already been used during year 'Y,' will be calculated as follows:

$$PAA_{Cj,G,Y} = RAA_{Cj,G,Y} * RVA_{Cj,G,Y} \quad \text{...(8)}$$

where:

$RAA_{Cj,G,Y}$ = Reduced proportion of OPC in unit volume of concrete mix *(in tonnes/ cubic meters)* in application 'G' during year 'Y',
$RVA_{Cj,Gx,Y}$ = Gross volume of concrete produced for use *(in cubic meters)* in application 'G' during year 'Y', and
G = Various grades of concrete mixes used at site 'Cj' during year 'Y'.

The total quantity of OPC that will be used for all grades of concrete mixes (G = 1, 2, ……) across several applications at concrete mix preparation location 'Cj' during year 'Y' will be calculated by adding the individual usages in several grades:

$$PAA_{Cj,Y} = \Sigma\ PAA_{Cj,G,Y} \quad \text{...(9)}$$

For step 3 (wherein only alternate cementitious material are added in the concrete mix), the requirement for OPC ($PAC_{Ck,G,Y}$ *in tonnes*) at concrete mix preparation location 'C_k' for concrete mix grade 'G' in which admixture has already been used during year 'Y,' will be calculated as follows:

$$PAC_{Ck,G,Y} = RAC_{Ck,G,Y} * RVC_{Ck,G,Y} \quad \text{...(10)}$$

where:

$RAC_{Ck,G,Y}$ = Reduced proportion of OPC in unit volume of concrete mix *(in tonnes/ cubic meters)* in application 'G' during year 'Y',
$RVC_{Ck,G,Y}$ = Gross volume of concrete produced for use *(in cubic meters)* in application 'G' during year 'Y', and
G = Various grades of concrete mixes used at site 'C_k' during year 'Y'.

The total quantity of OPC that will be used for all grades of concrete mixes (G = 1, 2, ……) across several applications at concrete mix preparation location 'C_k' during year 'Y' will be calculated by adding the individual usages in several grades:

$$PAC_{Ck,Y} = \Sigma\ PAC_{Ck,G,Y} \quad \text{...(11)}$$

During any year 'Y' the gross volume of concrete produced ($V_{C,G,Y}$) for use at all concrete mix preparation locations 'C' needs to conform to the following checks in relation baseline cement reduction calculations:

$$\mathbf{V_{C,G,Y} = RV_{Ci,G,Y} + RVA_{Cj,G,Y} + RVC_{Ck,G,Y}} \quad \text{.....(12)}$$

Considering the CO_2 emission factor for OPC production to be EF_{PC} *(in tonnes CO_2 emitted per tonne of cement produced)*[3], the annual emission (PL_{PC} *in tonnes*) of CO_2 in spite of the project activity is calculated as follows, using summation over all concrete mix preparation locations considered within the project boundary:

$$\mathbf{PL_{PC} = \sum (EF_{PC} * PA_{Ci,Y})} \quad \text{.....(13)}$$

D.8. Description of how the baseline methodology addresses any potential leakage of the project activity:

The likely leakages are:

1. due to additional transportation needs for sourcing OPC replacement materials compared to use of only OPC in the baseline;

2. due to savings in OPC consumption/ requirement as a result of the project activity, the demand for OPC use increases in other/ similar applications, encouraging more OPC production with associated GHG emissions; and

3. due to reduction in OPC content in concrete mix production, the durability (expected life-time) of constructed projects may decrease resulting requirement to use more OPC at a sooner date; such would generate need for producing more OPC, resulting in emission of more GHGs.

The leakage emissions under point number 1 could occur if the transportation needs for sourcing both OPC and replacement materials (in the project activity scenario) are greater than the transportation needs for sourcing only OPC (in the baseline scenario). In such an event, the leakage emissions due to additional transportation needs will be calculated as per the following algorithm.

Transportation needs (number of trucks required for transportation) for OPC in the baseline scenario:

$$\mathbf{BL_{TRANS} = Q_{OPC\_BL} / TC} \quad \text{.....(14)}$$

Transportation needs (number of trucks required for transportation) for OPC and 'Replacement Material in the project activity scenario':

$$\mathbf{PA_{TRANS} = (Q_{OPC\_PA} + Q_{RM\_PA}) / TC} \quad \text{.....(15)}$$

If $\mathbf{PA_{TRANS} > BL_{TRANS}}$, then leakage emissions ($\mathbf{LE_{TRANS}}$) will occur, that may be calculated as per the following formula, accounting for all concrete mix preparation locations identified in the project boundary.

$$\mathbf{LE_{TRANS} = \sum [(PA_{TRANS} - BL_{TRANS}) * AVD * TEF]} \quad \text{.....(16)}$$

where:

[3] Calculated as per procedure shown in equation (4).

BL_{TRANS} =	CO_2 emissions due to transport of OPC (baseline requirement) from one or more sources to any concrete mix locations considered in the project activity (tCO_2)
Q_{OPC_BL} =	Quantity of OPC transported from cement procuring sources to concrete mixing locations in the baseline scenario (tonnes)
Q_{OPC_PA} =	Quantity of OPC transported from cement procuring sources to concrete mixing locations in the project activity scenario (tonnes)
TC =	Truck capacity (tonnes of OPC or 'Replacement Material')
AVD =	Average return trip distance between the OPC or 'Replacement Material' procuring sources and corresponding locations for concrete mix preparation (km)
TEF =	CO_2 emission factor for the trucks (tCO_2/km).

The leakage discussed under point number 2 above is unlikely since such demand is likely to be inelastic, and the potential leakage will be zero. It will have to be demonstrated that such leakages are zero. Such a demonstration (to the Designated Operational Entity) may use impact of project activity on OPC price and price elasticity of OPC demand.

With appropriate QA/QC protocols (to be implemented as part of the monitoring methodology), reliability of the project activity should be demonstrated. Hence, there may not be incidences of occurrence of leakage discussed under point number 3 above. The applicability condition ensures that such leakages are absent.

D.9. Elaborate and justify formulae/algorithms used to determine the emissions reductions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

Based on the algorithm provided under D.6, D.7 and D.8, the annual emission reductions (ER_Y *in tonnes of* CO_2) due to the project activity can be calculated as follows, using formulae (5), (13) and (16):

$$ER_Y = BL_{PC} - PL_{PC} - LE_{TRANS} \quad \ldots\ldots (17)$$

SECTION E. Data sources and assumptions:

E.1. Describe parameters and or assumptions (including emission factors and activity levels):

The parameters and or assumptions are discussed below:

- ✓ the CO_2 emissions for manufacturing of a unit of OPC includes emissions from calcination and fuel/ power consumption for clinker production, grinding and blending operations;
- ✓ N_2O and CH_4 emissions are insignificant during production process of OPC;
- ✓ alternative cementitious material(s) to be used in the project activity for reducing OPC consumption are solid wastes from some industries, and hence GHG intensity of the material(s) would be zero; and
- ✓ GHG emissions during concrete mix preparation using admixture and alternative cementitious material(s) would be same as in the scenario wherein OPC is used in the place of alternate material.

E.2. List of data used indicating sources (e.g. official statistics, expert judgement, proprietary data, IPCC, commercial and scientific literature) and precise references and justify the appropriateness of the choice of such data:

List of data	Source(s) of data

List of data	Source(s) of data
Proportion of OPC in unit volume of concrete mix in application 'G' during any year 'Y' if standard mix design is to be used	Project sponsors database
Gross volume of concrete produced for use in application 'G' during year 'Y'	Relevant concrete mix preparation location's records
Number of grades of concrete mixes used at site 'C' during year 'Y'	Relevant concrete mix preparation location's records
Reduced proportion of OPC in unit volume of concrete mix in application 'G' during year 'Y' using admixture in the concrete mix and not any alternate cementitious material	Relevant concrete mix preparation location's records
Gross volume of concrete produced for use in application 'G' during year 'Y' using admixture in the concrete mix and not any alternate cementitious material	Relevant concrete mix preparation location's records
Various grades of concrete mixes used at site 'C_i' during year 'Y' where only admixture was used in the concrete mix	Relevant concrete mix preparation location's records
Reduced proportion of OPC in unit volume of concrete mix in application 'G' during year 'Y' by using both admixture and alternate cementitious materials	Relevant concrete mix preparation location's records
Gross volume of concrete produced for use in application 'G' during year 'Y' by using both admixture and alternate cementitious materials	Relevant concrete mix preparation location's records
Various of grades of concrete mixes used at site 'C_j' during year 'Y' where both admixture and alternate cementitious materials will be used	Relevant concrete mix preparation location's records
Reduced proportion of OPC in unit volume of concrete mix in application 'G' during year 'Y' by using only alternate cementitious materials	Relevant concrete mix preparation location's records
Gross volume of concrete produced for use in application 'G' during year 'Y' by using only alternate cementitious materials	Relevant concrete mix preparation location's records
Various of grades of concrete mixes used at site 'C_k' during year 'Y' where only alternate cementitious materials will be used	Relevant concrete mix preparation location's records
Annual quantity of fuel used in an OPC producing plant during a year prior to start of project activity crediting period	Official/ authentic publicly available record/ data for the OPC producing plant, such as Annual Report, etc.
Net calorific value for fuel used as above	As per IPCC
Carbon emission factor for fuel used	As per IPCC
Carbon oxidation factor for fuel used	As per IPCC
Annual quantity of OPC produced in the corresponding OPC producing plant (mentioned above) during a year prior to start of project activity crediting period	Official/ authentic publicly available record/ data for the OPC producing plant, such as Annual Report, etc.
Quantity of OPC transported from cement procuring sources to concrete mixing locations in the project activity	Project proponents records
Truck capacity	Project proponents records
Average return trip distance between the OPC procuring sources and corresponding locations under project activity	Project proponents records
CO_2 emission factor for the trucks	Relevant national level database or source, or IPCC.

E.3. Vintage of data (e.g. relative to starting date of the project activity):

All project data will be current or recently archived data collected from each concrete mix preparation location. The data for CO_2 emission factor will be the most recent data available in a country or sector scenario from national level database or authorized national entities.

E.4. Spatial level of data (local, regional, national):

The data required for application of the proposed methodology will have the following spatial levels:

Local	Baseline OPC usage data, and actual cement consumption data at per records relevant to implementation of the project activity.
Regional/ National	CO_2 emission factor from national level database or authentic source.
Global	CO_2 emission factor data from any acceptable international inventory if national level database or source is not available, and IPCC factors.

SECTION F. Assessment of uncertainties (sensitivity to key factors and assumptions):

1. The commensurate actual avoidance of OPC production based on the reduction in the quantity of its usage is uncertain; and

2. the market demand and supply of the saved quantity of OPC may not be reduced due to the project activity and hence GHG emissions may not be avoided by reducing the usage of OPC.

SECTION G. Explanation of how the baseline methodology allows for the development of baselines in a transparent and conservative manner:

1. the emission factor for CO_2 will be based on relevant national level GHG emission inventory, which makes emission reduction calculations transparent;

2. the data on baseline usage of OPC in various applications to which the project activity would be applied will be based on standardised design mixes specified by the relevant ‘national/ international level construction industry institutes/ regulatory bodies’, and hence the data would be transparent;

3. all data on actual OPC usage and quantity of concrete mix produced will be obtained from relevant laboratory and project activity implementation at concrete mix preparation location database, thereby ensuring that the data procurement is transparent; and

4. the methodology considers only CO_2 emissions in OPC manufacturing and not nitrous oxide N_2O and CH_4, which may also emitted in minor quantities, thus also making the baseline conservative.

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