SAMPLE EMISSION CALCULATIONS
FOR GRAIN ELEVATORS

The following emission calculations are provided only as an example. These calculations are based on typical equipment and commodities that are processed at a grain elevator operation. Emission calculations submitted to the TCEQ should include any assumptions and references for all emissions factors used and samples of all emission calculations performed. The following steps should be taken when calculating emissions from a grain elevator facility.

**Step 1.** Identify all emission points. Normally, these emission points are commodity receiving pits (truck or railcar), all open transfer points, any grain dryers, and commodity loadout areas (truck or railcar).

**Step 2.** List all commodities received including hourly and annual receiving rates. Hourly receiving rates are determined by the maximum number of truck or railcar loads that can be unloaded in the facility's receiving pits in one hour. Annual receiving rates are estimated on the annual usage of each commodity. An estimation of receiving rates should be conducted for all commodities.

**Step 3.** Make a fan chart for all proposed abatement devices including the emission point number, the fan’s purpose (i.e. truck receiving), type of control device (i.e. bagfilter), and average and maximum flow rates (dscfm).

**Step 4.** Estimate the hourly and annual emission rates for each emission point. All emission rates should be based on the maximum hourly and annual throughput capacity for that particular emission point. In addition, any control efficiencies used to reduce the emissions from an emission point should be justified and provided in the emission calculations.
EXAMPLE CALCULATIONS

Emission Points

Emission Point No. 1: Truck Receiving Pit
Emission Point No. 2: Railcar Receiving Pit No. 1 Bagfilter
Emission Point No. 3: Railcar Receiving Pit No. 2
Emission Point No. 4: Truck Loadout
Emission Point No. 5: Dryer
Emission Point No. 6: Cleaner

Commodities Received in Truck and Railcar Receiving Pits

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grains</td>
<td>25</td>
<td>200</td>
<td>8</td>
<td>1</td>
<td>200</td>
<td>200</td>
<td>100,000</td>
<td>336,200</td>
</tr>
<tr>
<td>Soybean Meal</td>
<td>25</td>
<td>200</td>
<td>8</td>
<td>1</td>
<td>200</td>
<td>200</td>
<td>45,400</td>
<td>100,000</td>
</tr>
<tr>
<td>Totals:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>145,400</td>
<td>436,200</td>
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</tbody>
</table>

Grain Cleaning Throughputs

<table>
<thead>
<tr>
<th>Emission Point No.</th>
<th>Purpose</th>
<th>Control Device</th>
<th>Hourly Tonnage Cleaned</th>
<th>Annual Tonnage Cleaned</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Grain Cleaning Operations</td>
<td>Cyclone</td>
<td>84</td>
<td>350,000</td>
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</tbody>
</table>

Fan Chart

<table>
<thead>
<tr>
<th>Emission Point No.</th>
<th>Purpose</th>
<th>Control Device</th>
<th>Expected Flowrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Railcar Receiving Pit No. 1</td>
<td>Baghouse</td>
<td>12,400 (dscfm)</td>
</tr>
</tbody>
</table>
EMISSION CALCULATIONS FOR TRUCK AND RAILCAR RECEIVING

1. TRUCK RECEIVING PIT:

   ■ Assume emissions are reduced by 90% during choke feeding, which is already included in the emission factors.

   ■ Assume that PM is total particulate matter, suspended in the atmosphere.

**Hourly:**

\[
PM = 200 \text{ tons} \times 0.017 \text{ lbs}^{(a)} = 3.40 \text{ lbs} \quad \text{ton} \quad \text{hour}
\]

\[
PM_{10} = 200 \text{ tons} \times 0.0025 \text{ lbs}^{(a)} = 0.50 \text{ lbs} \quad \text{ton} \quad \text{hour}
\]

**Annual:**

\[
PM = 145,400 \text{ tons} \times 0.017 \text{ lbs}^{(a)} \times 1 \text{ ton} = 1.24 \text{ tons} \quad \text{year} \quad 2000 \text{ lbs} \quad \text{year}
\]

\[
PM_{10} = 145,400 \text{ tons} \times 0.0025 \text{ lbs}^{(a)} \times 1 \text{ ton} = 0.18 \text{ tons} \quad \text{year} \quad 2000 \text{ lbs} \quad \text{year}
\]

2. RAILCAR RECEIVING PIT NO. 1 (BAGFILTER SYSTEM):

   ■ Assume that since this railcar receiving area is in a building with suction being pulled and the doors are closed while receiving grain and commodities, this emission point will not have any fugitive emissions. The only emissions from this point will be point source emissions from the bagfilter system.

   ■ Assume emissions from the bagfilter are PM$_{10}$ or smaller.

**Hourly:**

\[
PM_{10} = 0.01 \text{ gr}^{(b)} \times 12,400 \text{ dscf} \times \frac{1 \text{ lb}}{7000 \text{ grains}} \times 60 \text{ min.} = 1.06 \text{ lbs} \quad \text{hour}
\]

**Annual:**

   ■ Assume this railcar receiving pit receives half of the total annual railcar throughput.

Total Material Received = 436,200 tons/yr ÷ 2

\[
= 218,100 \text{ tons/year}
\]

\[
PM_{10} = 1.06 \text{ lbs} \times 218,100 \text{ tons} \div 200 \text{ tons} \times 1 \text{ ton} = 0.58 \text{ tons} \quad \text{hour} \quad \text{year} \quad 2000 \text{ lbs} \quad \text{year}
\]
3. **RAILCAR RECEIVING PIT NO. 2:**

- Assume emissions are reduced by 90% during choke feeding.
- Assume PM is total particulate matter, suspended in the atmosphere.

**Hourly:**

\[
PM = 200 \text{ tons} \times 0.017 \text{ lbs(\text{a})} = 3.40 \text{ lbs/ton hour}
\]

\[
PM_{10} = 200 \text{ tons} \times 0.0025 \text{ lbs(\text{a})} = 0.50 \text{ lbs/ton hour}
\]

**Annual:**

- Assume this railcar receiving pit receives half of the total annual railcar throughput.

Total Material Received = 436,200 tons/yr ÷ 2

\[= 218,100 \text{ tons/year}\]

\[
PM = 218,100 \text{ tons} \times 0.017 \text{ lbs(\text{a})} \times \frac{1}{2000 \text{ lbs}} = 1.85 \text{ tons/year}
\]

\[
PM_{10} = 218,100 \text{ tons} \times 0.0025 \text{ lbs(\text{a})} \times \frac{1}{2000 \text{ lbs}} = 0.27 \text{ tons/year}
\]

4. **TRUCK LOADOUT:**

- Assume no more than one truck loads out at a time.
- Assume the loadout area is totally enclosed with no suction being pulled; assume 90% control of emissions.
- Assume PM is total particulate matter suspended in the atmosphere.

**Hourly:**

8 trucks/hr x 25 tons/truck = 200 tons/hr

\[
PM = 200 \text{ tons} \times 0.086 \text{ lbs(\text{c})} \times (1-.90) = 1.72 \text{ lbs/ton hour}
\]

\[
PM_{10} = 200 \text{ tons} \times 0.029 \text{ lbs(\text{c})} \times (1-.90) = 0.58 \text{ lbs/ton hour}
\]
Annual:

Total Materials = 145,400 TPY + 436,200 TPY

= 581,600 TPY

\[
\text{PM} = 581,600 \text{ tons} \times 0.086 \frac{\text{lbs}}{\text{ton}} \times (1-0.90) \times \frac{1}{2000 \text{ lbs}} = 2.50 \text{ tons/year}
\]

\[
\text{PM}_{10} = 581,600 \text{ tons} \times 0.029 \frac{\text{lbs}}{\text{ton}} \times (1-0.90) \times \frac{1}{2000 \text{ lbs}} = 0.84 \text{ tons/year}
\]

5. DRYER:

- Assume 3000 bushels/hour (84 tons/hour) commercial dryer at 2.9 million BTU/hour.
- Assume maximum fuel flow rate of 2,990 ft³/hour and 26,186,000 ft³/year of natural gas.
- Assume only non-methane VOC emissions are quantified (8.0 lbs/10⁶ ft³ x 0.66 non-methane emissions = 5.28 lbs/10⁶ ft³).
- Assume maximum annual throughput: 15% of grain received (87,000 TPY)

Hourly:

\[
\text{PM} = 84 \text{ tons/hour} \times 0.22 \frac{\text{lbs}}{\text{ton}} = 18.48 \text{ lbs/hour (grain dust)}
\]

\[
\text{PM}_{10} = 84 \text{ tons/hour} \times 0.055 \frac{\text{lbs}}{\text{ton}} = 4.62 \text{ lbs/hour (grain dust)}
\]

\[
\text{PM}_{10} = 2,990 \text{ ft}^3/\text{hour} \times 7.6 \frac{\text{lbs}}{10^6 \text{ ft}^3} = 0.02 \text{ lbs/hour (products of combustion)}
\]

\[
\text{SO}_2 = 2,990 \text{ ft}^3/\text{hour} \times 0.6 \frac{\text{lbs}}{10^6 \text{ ft}^3} = 0.002 \text{ lbs/hour}
\]

\[
\text{NO}_x = 2,990 \text{ ft}^3/\text{hour} \times 100 \frac{\text{lbs}}{10^6 \text{ ft}^3} = 0.30 \text{ lbs/hour}
\]

\[
\text{CO} = 2,990 \text{ ft}^3/\text{hour} \times 84 \frac{\text{lbs}}{10^6 \text{ ft}^3} = 0.25 \text{ lbs/hour}
\]

\[
\text{VOC} = 2,990 \text{ ft}^3/\text{hour} \times 5.5 \frac{\text{lbs}}{10^6 \text{ ft}^3} = 0.02 \text{ lbs/hour}
\]
**Annual:**

- For annual emissions (including combustion emissions), assume the dryer operates only when grain is actually being dried (i.e. 87,000 tons/yr ÷ 84 tons/hr = 1036 hrs/yr). Calculate grain dust PM$_{10}$ on maximum annual throughput.

\[
PM = 87,000 \text{ tons} \times 0.22 \frac{\text{lbs}(c)}{\text{ton}} \times \frac{1}{2000 \text{ lbs}} = 9.57 \text{ tons} \quad \text{(grain dust)}
\]

\[
PM_{10} = 87,000 \text{ tons} \times 0.055 \frac{\text{lbs}(c)}{\text{ton}} \times \frac{1}{2000 \text{ lbs}} = 2.39 \text{ tons} \quad \text{(grain dust)}
\]

\[
PM_{10} = 0.02 \frac{\text{lbs}}{\text{yr}} \times 1036 \frac{\text{hr}}{\text{yr}} \times \frac{1}{2000 \text{ lbs}} = 0.01 \text{ tons} \quad \text{(products of combustion)}
\]

\[
SO_2 = 0.002 \frac{\text{lbs}}{\text{yr}} \times 1036 \frac{\text{hr}}{\text{yr}} \times \frac{1}{2000 \text{ lbs}} = 0.001 \text{ tons}
\]

\[
NO_x = 0.30 \frac{\text{lbs}}{\text{yr}} \times 1036 \frac{\text{hr}}{\text{yr}} \times \frac{1}{2000 \text{ lbs}} = 0.16 \text{ tons}
\]

\[
CO = 0.25 \frac{\text{lbs}}{\text{yr}} \times 1036 \frac{\text{hr}}{\text{yr}} \times \frac{1}{2000 \text{ lbs}} = 0.13 \text{ tons}
\]

\[
VOC = 0.02 \frac{\text{lbs}}{\text{yr}} \times 1036 \frac{\text{hr}}{\text{yr}} \times \frac{1}{2000 \text{ lbs}} = 0.01 \text{ tons}
\]

**6. CLEANER:**

**Hourly:**

\[
PM = 84 \text{ tons} \times 0.075 \frac{\text{lbs}(c)}{\text{ton}} = 6.30 \text{ lbs}
\]

\[
PM_{10} = 84 \text{ tons} \times 0.019 \frac{\text{lbs}(c)}{\text{ton}} = 1.60 \text{ lbs}
\]

**Annual:**

\[
PM = 350,000 \text{ tons} \times 0.075 \frac{\text{lbs}(c)}{\text{ton}} \times \frac{1}{2000 \text{ lbs}} = 13.13 \text{ tons}
\]

\[
PM_{10} = 350,000 \text{ tons} \times 0.019 \frac{\text{lbs}(c)}{\text{ton}} \times \frac{1}{2000 \text{ lbs}} = 3.33 \text{ tons}
\]
References:

All assumptions should be justified and references should be provided where applicable.

(a) AP-42, EPA Compilation of Air Pollutant Emission Factors, Particulate Emission Factors for Grain Processing Facilities, Table 9.9.1-2, 2003. Assume dust generated during the receiving of all bulk commodities is similar to the receiving operations at an animal feedmill.

(b) AP-40, Air Pollution Engineering Manual, Air and Waste Management Association, 1991, pg 115. "Well designed and operated baghouses have been shown to be capable of reducing overall particulate emissions to less than 0.01 gr/dscf...."in some cases as low as 0.01 - 0.005 gr/dscf".


(d) Accepted efficiencies given for certain control devices/measures that minimize fugitive emissions only (not to be utilized on point sources). Any other control efficiencies should be well justified and submitted with references if possible. Accepted efficiencies include:

- Enclosed receiving or loadout area with doors and/or flexible strips (canvas or plastic) and suction being pulled = 100%

- Flexible strips (canvas or plastic) and choke feeding = 95%

- Enclosed receiving or loadout area with no suction = 90%

- Choke feeding on receiving operations = 90%

- Mineral oil application = 90%

(e) AP-42, EPA Compilation of Air Pollutant Emission Factors from Natural Gas Combustion, Table 1.4-1, 1.4-2, and 1.4-3, 1998.

Best Available Control Technology emission factors determined for fuel fired equipment. Any other emission factors or control efficiencies should be well justified and submitted with references if possible. Accepted factors include:

NO\textsubscript{X} emission factor for fuel fired equipment with an hourly BTU rating greater than 10 million and less than or equal to 40 million = 0.10 lb/10\textsuperscript{6} BTU

NO\textsubscript{X} emission factor for fuel fired equipment with an hourly BTU rating greater than 40 million = 0.06 lb/10\textsuperscript{6} BTU