Health and environmental impacts of platinum mining: Report from South Africa

Eugene Cairncross,
on behalf of PHM
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Timeline: Impacts of the mining life cycle

Exploration Mine development, construction

?years

Invasion of land

Occupation of land, displacement of people, influx

3-5+ years

Mineral resource

Mining, exploitation of mineral resource

20 to 50+ years

Air and water pollution, solid waste dumps, dust, loss of land, social impacts

Closure and abandonment

Air and water pollution, solid waste dumps, dust, loss of land, financial costs

?100’s of years?

Platinum mining in South Africa

- Platinum mining in SA is comparatively recent, supply increasing from 1.76 million ounces (50 tons) in 1975 to a peak of 4.86 million ounces (138 tons) in 2011. Value of 2012 output, about R56 billion.

- SA currently produces about 75% of world production

- Uses: 38% for vehicle emission control devices (catalytic converters), 31% for jewelry, 25% industrial uses and 7% for investment

- Amplats, Impala Platinum and Lonmin, the three largest producers, produced a total of 158 tons in 2011, and employed a total of 160 000 employees

- The value of the cumulative SA production of 3900 tons for the years 1975 to 2012 (Johnson Matthey, 2013) is, at the December 2012 price, about US$200 billion, about R2 000 billion or R2 trillion.
Platinum process, resource consumption and impacts

Above ground or below ground mining
- Blasting operations
- Noise, dust, ground vibrations

Rock crushing and milling
- Crushing and milling operations
- Dust, energy consumption

Flotation and drying
- Production of concentrate
- Energy and water consumption, slurry of fine rock and chemicals deposited on slimes dams. Dust, water pollution

Smelting and refining
- Recovering platinum from concentrate
- Air pollution (dust, sulphur dioxide). Energy consumption (electric arc furnace, electrowinning)
The main environmental impacts of platinum mining

- **Solid waste – tailings dams and waste rock dumps**
  - 580 000 tons ore/ton Pt produced;
  - Plus waste rock: 20% – 90% of ore (UGM)

- **Water consumption**: 273 to 544 m³/kg PGM (average about 400 m³/kg)

- **Energy consumption (mine, concentrator and smelter)**: 168 to 256 GJ/ kg PGM

- **CO₂e emissions**: 40 to 50 t/kg PGM

- **SO₂ and dust emissions??**

- **Water pollution?** (acidic seepage and runoff, AMD?)
Farming land taken over by mining operations and fenced off
Surface platinum mining operations
Dust storm off a platinum tailings dump
Resettlement camp, Wonderkop district
Health impacts of SO2 exposure

Health Effects of sulphur dioxide (SO$_2$)*:

- Decreased lung function,
- Respiratory illness,
- Alterations in pulmonary defences,
- Aggravation of existing cardiovascular disease.
- In children, the elderly and people with asthma are most susceptible to cardiovascular disease or chronic lung disease (such as bronchitis or emphysema).

- Increased daily mortality
- No safe level

South African Ambient Air Quality Standard (SAAAQS) for SO$_2$

<table>
<thead>
<tr>
<th></th>
<th>24 hours</th>
<th>1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>125 µg/m$^3$ (48 ppb)</td>
<td>50 µg/m$^3$ (19 ppb)</td>
</tr>
</tbody>
</table>

**WHO Guideline values for SO$_2$**:  
Daily average value: 20 µg/m$^3$  
(This is also the WHO yearly average guideline value.)

*WHO, 2006*
### Control of SO₂ Smelter and converter emissions: Listed Activities under AQA

#### Subcategory 4.16: Smelting and Converting of Sulphide Ores

<table>
<thead>
<tr>
<th>Substance or mixture of substances</th>
<th>Common name</th>
<th>Chemical symbol</th>
<th>Plant status</th>
<th>mg/Nm³ under normal conditions of 273 Kelvin and 101.3 kPa.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Particulate matter</td>
<td>N/A</td>
<td>New</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Existing</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Oxides of nitrogen</td>
<td>NOₓ expressed as NO₂</td>
<td>New</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Existing</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>Sulphur dioxide (feed SO₂ &lt;5% SO₂)</td>
<td>SO₂</td>
<td>New</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Existing</td>
<td>3500</td>
</tr>
<tr>
<td></td>
<td>Sulphur dioxide (feed SO₂ &gt;5% SO₂)</td>
<td>SO₂</td>
<td>New</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Existing</td>
<td>2500</td>
</tr>
</tbody>
</table>

(a) The following special arrangement shall apply –

All facilities must install apparatus for the treatment of the sulphur content of the off-gases.
Mines and smelters

Excerpted from Glaister and Mudd, 2010.
Health impacts of dust (PM10/PM2.5) exposure

- Two sizes, PM10 and PM2.5
- The smaller size, PM2.5, is the more health damaging, effects occur at lower concentrations
- Health impacts: effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, are especially sensitive to the effects of particulate matter.*

- There is no safe level*

The SA PM10 Standard:

<table>
<thead>
<tr>
<th>Averaging Period</th>
<th>Concentration</th>
<th>Frequency of Exceedence</th>
<th>Compliance Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>120μg/m³</td>
<td>4</td>
<td>Immediate – 31 December 2014</td>
</tr>
<tr>
<td>24 hours</td>
<td>75 μg/m³</td>
<td>4</td>
<td>1 January 2015</td>
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<tr>
<td>1 year</td>
<td>50 μg/m³</td>
<td>0</td>
<td>Immediate – 31 December 2014</td>
</tr>
<tr>
<td>1 year</td>
<td>40 μg/m³</td>
<td>0</td>
<td>1 January 2015</td>
</tr>
</tbody>
</table>

The WHO Guideline Value*:

\[
P_M^{10}: 20 \, \mu g/m^3 \text{ annual mean} \\
50 \, \mu g/m^3 \text{ 24-hour mean}
\]

*WHO, 2006
### The PM2.5 Standard

<table>
<thead>
<tr>
<th>Averaging Period</th>
<th>Concentration</th>
<th>Frequency of Exceedence</th>
<th>Compliance Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>65 μg/m³</td>
<td>4</td>
<td>Immediate - 31 December 2015</td>
</tr>
<tr>
<td>24 hours</td>
<td>40 μg/m³</td>
<td>4</td>
<td>1 January 2016 - 31 December 2029</td>
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<tr>
<td>24 hours</td>
<td>25 μg/m³</td>
<td>4</td>
<td>1 January 2030</td>
</tr>
<tr>
<td>1 year</td>
<td>25 μg/m³</td>
<td>0</td>
<td>Immediate - 31 December 2015</td>
</tr>
<tr>
<td>1 year</td>
<td>20 μg/m³</td>
<td>0</td>
<td>1 January 2016 - 31 December 2029</td>
</tr>
<tr>
<td>1 year</td>
<td>15 μg/m³</td>
<td>0</td>
<td>1 January 2030</td>
</tr>
</tbody>
</table>

**WHO Guideline**

$\text{PM}_{2.5}^*$:  
10 μg/m³ annual mean  
25 μg/m³ 24-hour mean

*WHO, 2006
Dust Control Regulations

Promulgated 01 November 2013

- “The purpose of the regulations is to prescribe general measures for the control of dust in all areas.”

- “"premises" means any land and structures thereon including stockpiles of materials, roadways and other means of conveyance, from which dust may be generated through anthropogenic or natural activities or processes;

(Refer to Dust Control Regs)
But, the Dust Control regulation is problematic:

(2) The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body.

4. Dustfall monitoring programme

(1) The air quality officer may require any person, through a written notice, to undertake a dustfall monitoring programme as contemplated in subregulation (5) if:

(a) the air quality officer reasonably suspects that the person is contravening regulation 3; or

(b) the activity being conducted by the person requires a fugitive dust emission management plan as per the notice published in terms of section 21 of the Act.

Comment: The sampling bucket system described in ASTM D1739: 1970 is a very poor measuring instrument.
Using the CER Mining Environmental Rights Toolkit