Assessment of Occupational Safety and Health Hazards Exposure of Workers in Small Scale Gold Mining

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Outline of Presentation

1. Background
2. Research Questions
3. Methodology, Selection of Study Areas & Limitations
4. Results and Findings
5. Conclusion
6. Recommendations
7. Challenges
## Background

### Assessment of OSH Hazards Exposure of Workers in SSGM

- ASSM – **Informal & out of the mainstream**
- The **Philippines ranks 22**<sup>nd</sup> among the list of world’s gold producing countries in 2017 and **5th** among the 6 Asian countries producing 91% of the precious metal in the continent
- About **236,000 workers** are employed in mineral industry (EMB-DENR, 2016)
- The Occupational Safety and Health Center, DOLE recognizes the need to **protect of human health and the environment**
- **The ILO and OSHC collaboration**
- The **first study with actual measurement of health hazards**
Research Questions

- What are the **working conditions, work practices and levels of exposure** of workers to physical and chemical hazards and other OSH hazards during extraction and gold processing activities in selected small scale gold mining in the Philippines?

- What are the **gaps** (if there are) in the small scale gold mining related safety and health policies and standards and their implementation?
QUALITATIVE & QUANTITATIVE SCIENTIFIC RESEARCH

1. Qualitative Data Collection
   a. Key informant interview – structured questionnaire-guided interview
   b. Walk-thru, work process or work practice observation – identification of OSH hazards

2. Quantitative Data Collection
   a. Measurement of physical and chemical hazards using industrial hygiene equipment
   b. Laboratory analysis of WEM samples collected and silica content (%) in ore and/or tailings collected
   c. Comparison with OSHS, DOLE and other references
Study Areas:
Small Scale Gold Mining in the Phils.

- CAR
- Region 5
- Region 9
- Region 11
- Region 12
- Region 13

16 Gold Processing Plants/Areas
14 Small Scale Gold Mine Sites
Limitations of the Study

• Limited number of fully operating SSGM due to “no-permit - closure” issues
• Awareness on RA 9231 on Child Labor and prohibition on the use of mercury
• Condition underground (sampling equipment)
• Weather condition and location
• Safety and security of research team
Small Scale Gold Mining Process
Gold Processing

1. Feeding
2. Crushing/Grinding
3. Leaching/Precipitation
4. Ashing
5. Retorting Melting (Separate Ag & Au)
6. Refining
## Chemical Hazards: SILICA DUST

### Exposure of Workers

<table>
<thead>
<tr>
<th>Conc. Total Dust</th>
<th>TLV</th>
<th>Conc. Respirable Dust</th>
<th>TLV</th>
<th>%silica</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.61</td>
<td>0.347</td>
<td>1.17</td>
<td>0.117</td>
<td>83.33</td>
</tr>
<tr>
<td>3.21</td>
<td>0.586</td>
<td>2.41</td>
<td>0.199</td>
<td>48.17</td>
</tr>
<tr>
<td>2.15</td>
<td>0.491</td>
<td>1.69</td>
<td>0.166</td>
<td>58.06</td>
</tr>
<tr>
<td>2.56</td>
<td>0.512</td>
<td>1.54</td>
<td>0.174</td>
<td>55.54</td>
</tr>
<tr>
<td>5.33</td>
<td>0.451</td>
<td>3.50</td>
<td>0.153</td>
<td>63.45</td>
</tr>
<tr>
<td>4.45</td>
<td>0.347</td>
<td>2.91</td>
<td>0.117</td>
<td>83.33</td>
</tr>
<tr>
<td>10.29</td>
<td>0.451</td>
<td>6.18</td>
<td>0.173</td>
<td>63.45</td>
</tr>
<tr>
<td>13.33</td>
<td>0.471</td>
<td>8.00</td>
<td>0.159</td>
<td>60.71</td>
</tr>
</tbody>
</table>

Ore Feeding & Ball Mill Operation
Chemical Hazards: CYANIDE & NITRIC ACID

Cyanide Preparation & Cyanidation/Agitation Process

Retorting, Smelting & Refining Processes

Passed TLV, OSHS = 10 ppm

Passed to Action Level TLV = 2 ppm
Chemical Hazards: CARBON MONOXIDE & OTHER GASES

**Carbon Monoxide**

<table>
<thead>
<tr>
<th>Location</th>
<th>CO, ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHING ROOM</td>
<td>125</td>
</tr>
<tr>
<td>TAILINGS POND (NEAR ASHING)</td>
<td>202</td>
</tr>
<tr>
<td>REST AREA (NEAR ASHING)</td>
<td>106</td>
</tr>
<tr>
<td>FIRING</td>
<td>4</td>
</tr>
</tbody>
</table>

**TLV, OSHS = 50 ppm**

### Underground Mine Sites

<table>
<thead>
<tr>
<th>AT</th>
<th>RH</th>
<th>O2</th>
<th>CO</th>
<th>H2S</th>
<th>VOC</th>
<th>Comb. Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-33°C</td>
<td>78-99%</td>
<td>19.6 – 21.3%</td>
<td>&lt; 1 ppm</td>
<td>&lt; 1 ppm</td>
<td>ND</td>
<td>0</td>
</tr>
</tbody>
</table>

**TLV, OSHS**

| 50 ppm | 10 ppm |

**OSHA 29 CFR 1926.1202**

| 19.5 - 23.5% |
Physical Hazards: NOISE

BALL/ROD MILL AREA

65% - FAILED  20% ACTION LEVEL  15% - PASSED

Failed: 91 -100 dBA
Action Level: 87 – 89 dBA
Passed: 80 – 82 dBA

PNEL Table indicating the different sound levels and its corresponding allowable hours of exposure. OSHS, DOLE

<table>
<thead>
<tr>
<th>Duration per day, hours</th>
<th>Sound Levels, dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2</td>
<td>102</td>
</tr>
<tr>
<td>AGITATION/LEACHING</td>
<td>FIRING</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Noise level</td>
<td>GPP</td>
</tr>
<tr>
<td>89</td>
<td>GP1</td>
</tr>
<tr>
<td>89</td>
<td>GP1</td>
</tr>
<tr>
<td>101</td>
<td>GP4</td>
</tr>
<tr>
<td>77</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>GP4</td>
</tr>
<tr>
<td>82</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

Blasting inside tunnel: 115 dBA  Drilling inside tunnel: 82-85 dBA
Health Hazards: HEAT STRESS

WBGT INDEX (HEAT STRESS)

Recommended WBGT Index: 30°C
Action Limit: 27°C
Moderate Workload – REFINING/RETORTING
25% to 50% Allocation of Work
Reference: ACGIH

- GP1: 28.5°C
- GP3: 31.2°C
- GP4: 30.8°C
- GP11: 28.8°C
- GP16: 30.9°C

60% 40%
Gold Processing Plants: VENTILATION

Air Velocity (meter per second)
Ball Mill/Agitation/Refining

- **Refining**
  - Passed (0.25 m/sec)
  - Failed (0.05 – 0.15 m/sec)

- **Agitation Tanks**
  - Passed

- **Ball Mill**
  - Passed

- Enclosed workarea
- Semi-open or open area
Underground Mining
VENTILATION/OXYGEN LEVEL

Minimum Air Velocity Standard, OSHS-DOLE
0.25 m/sec

<table>
<thead>
<tr>
<th>Measuring Point</th>
<th>Air Velocity (m/sec)</th>
<th>Oxygen Level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point A (entrance of horizontal tunnel)</td>
<td>0.28</td>
<td>21.3</td>
</tr>
<tr>
<td>Point B (300 meters from the entrance)</td>
<td>0.15</td>
<td>21</td>
</tr>
<tr>
<td>Point C (480 meters from the entrance)</td>
<td>0.14</td>
<td>20.5</td>
</tr>
</tbody>
</table>

Point D (drive (branch) from Point C)
0.12 m/sec, 20.5% oxygen level

Point E (640 meters from the entrance)
0.1 m/sec, 20.8% oxygen level

Point F (sinking - about 60 m deep)
0.08 m/sec, 20.5% oxygen level

O2 level based on OSHA 29 CFR 1926.1202 = 19.5% – 23.5%
Identified Health Hazards

Biological Hazards
Identified Health Hazards

- Ergonomic Hazards
- Psychosocial Hazards
Safety Hazards: GPP
Safety Hazards: GPP
Observed Chemical Related Hazards & Work Practices
Safety Hazards: Underground Mining

- Stope (structure) collapse
- Cave-in
- Flood (water inrushes)
- Loose rocks or debris
- Fire
- Blasting related hazards
- Improper choice of working tools
- Mechanical & electrical hazards
Condition of Processing Plants After Closure
# Conclusion

## Are Workers in Underground Mining and Gold Processing Exposed to Different Safety and Health Hazards While at Work?

1. Various **safety hazards** (mechanical, electrical, etc.) - easily identified or seen but were **not given attention**.

2. Different **health hazards** such as noise, silica dust and other chemicals but **no measurement or exposure monitoring** has been conducted.

3. **Absence of risk based programs** to address workers’ protection
CONCLUSION

There are **identifiable gaps** on the needs of the workers **vis-à-vis** current Small Scale Gold Mining OSH-related laws and policies.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OSHS, DOLE - Rule 1003.04: Application to Mines</td>
</tr>
<tr>
<td>2.</td>
<td>MGB, DENR AO 97-30: WEM, OELs, Risk-based Health Programs and Guidelines on the “temporary” or “permanently” closed processing plants</td>
</tr>
<tr>
<td>3.</td>
<td>Safety and Health in Mines Convention (C176)</td>
</tr>
<tr>
<td>4.</td>
<td>Overlapping and sometimes conflicting OSH-related policies among concerned national and local governments</td>
</tr>
</tbody>
</table>
## RECOMMENDATIONS

### BRIDGING THE GAPS ON THE NEEDS OF WORKERS IN SSGM & PROCESSING FROM OSH STANDPOINT

### MULTI-STAKE HOLDERS PARTNERSHIP

1. Big Brother (Large Scale Mines) - Small Brother (Small Scale Mines) Partnership to Occupational Safety and Health

2. Training/Awareness of all concerned - Training Needs Assessment

3. Central Safety and Health Committee – PMRB, LGU, SSMA, Permittee (with defined roles and responsibilities)

4. Need to revisit all OSH in mines related policies/issuances (look for the missing links)
## CHALLENGES

**GOAL (ROLE):** GOVERNMENT SHOULD PROVIDE DECENT WORK

<table>
<thead>
<tr>
<th>Craft</th>
<th><strong>UNIFIED OSH POLICIES/REGULATIONS SPECIFIC TO SMALL SCALE (GOLD) MINING SECTOR</strong> WITHOUT SACRIFICING THEIR INCOME AND THE ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>A COMPREHENSIVE HEALTH SURVEILLANCE SYSTEM</strong> TO ENHANCE WORKERS PROTECTION, SOCIAL BENEFITS AND EMPLOYEES COMPENSATION</td>
</tr>
<tr>
<td></td>
<td><strong>DEVELOPMENT OF RISK-BASED HYGIENE MANAGEMENT PLAN</strong> TO ADDRESS SMALL SCALE MINE-SPECIFIC OSH HAZARDS, MONITORING PROGRAMS AND CONTROL MEASURES ALIGNED TO THE NEEDS OF SSGM WORKERS</td>
</tr>
<tr>
<td></td>
<td><strong>FORMALIZATION AS THE ANSWER TO WORKERS MAXIMUM PROTECTION</strong></td>
</tr>
</tbody>
</table>
Finally...

“Ang mga minerong malusog at ligtas, haligi ng magandang bukas.”
Thank you