



The present work was submitted to the Faculty of Engineering

**Identification of industrial waste liquids applicable  
for the suppression of mining and processing  
generated dust**

**Bachelor Thesis**

by

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# Statutory Declaration

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I hereby affirm in lieu of an oath that I provided the submitted bachelor thesis

Identification of industrial waste liquids applicable for the suppression of mining and processing generated dust

independently and without undue external help. I did not use any sources other than those stated. In case that the work is additionally submitted on a data medium, I declare that the written and the electronic form are completely identical. The work was not submitted in the same or similar form to any examination authority.

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## 1. Introduction

### 1.1 Background

The Industrial Revolution, which took place from the 18<sup>th</sup> to 19<sup>th</sup> centuries, was a period during which predominantly agrarian, rural societies became industrial and manufacturing-dominated ones. Industrialization marked a shift to powered, special-purpose machinery, factories and mass production. Industrialization progressed by help of more and more natural resources to speed up productions. Since then mining industry plays significant transformation during the Industrial revolution time. At this time the Mineral revolution began with the discovery of diverse kind of natural resources became essential materials, used to make everything from appliances, tools and machines, to ships, building and infrastructure. While industrialization brought about an increased volume and variety of manufactured goods and an improved standard of living for some, it also raises some issues that were amplified by the developing industry. The global challenges of global warming, destruction of wildlife habitat and air pollution can be traced back to this moment in human history. In particular, the world's mining environmental problems began by the Industrial Revolution. A mining operation can have significant impacts on its surrounding Environment during all phases like active and abandoned mines. In primary process of mining operations include extraction (loosening of the mineral from the ground and loading on transport equipment), transporting (transport of the extract material with transport equipment from the extraction place to destination point) and dumping (unloading of the transported material). Those major mining operations have been source of atmospheric dust emissions since industrialization began. Dust is formed by non-usable part of the mineral production consists of mineral with insufficient concentration, material with a high share of trace minerals and tailings. The Mine Safety and Health Administration (MSHA) defines dust as: "Finely divided solids that may become airborne from the original state without any chemical or physical change other than fracture".

### 1.2 Health issues related to human dust intake:

On a long-term effect of occupational dust exposure appeared millions of workers. Dust in mine can pose several hazards. Miners in the working area developed medical problems. The dust pollution were constantly in the air led to the illness knows as ill fever. Firstly, the analogy of the dust can be extended further issues like physiological and health hazards such as lung cancer, asthma, bronchitis and pneumoconiosis

(genetic term for damage to cardio-respiratory organs caused by inhalation of dust). study, dust-exposed workers compared to unexposed workers showed a reduced survival of age 60 ( $p$  less than 0.0001), due to lung cancer (123 exposed, 87 controls,  $p = 0.007$ ), stomach cancer (48/23,  $p = 0.003$ ), silicosis (40/0), emphysema, bronchitis and asthma (41/23,  $p = 0.007$ ). No difference in mortality from cardiovascular diseases was observed ( $p$  greater than 0.50)(1).

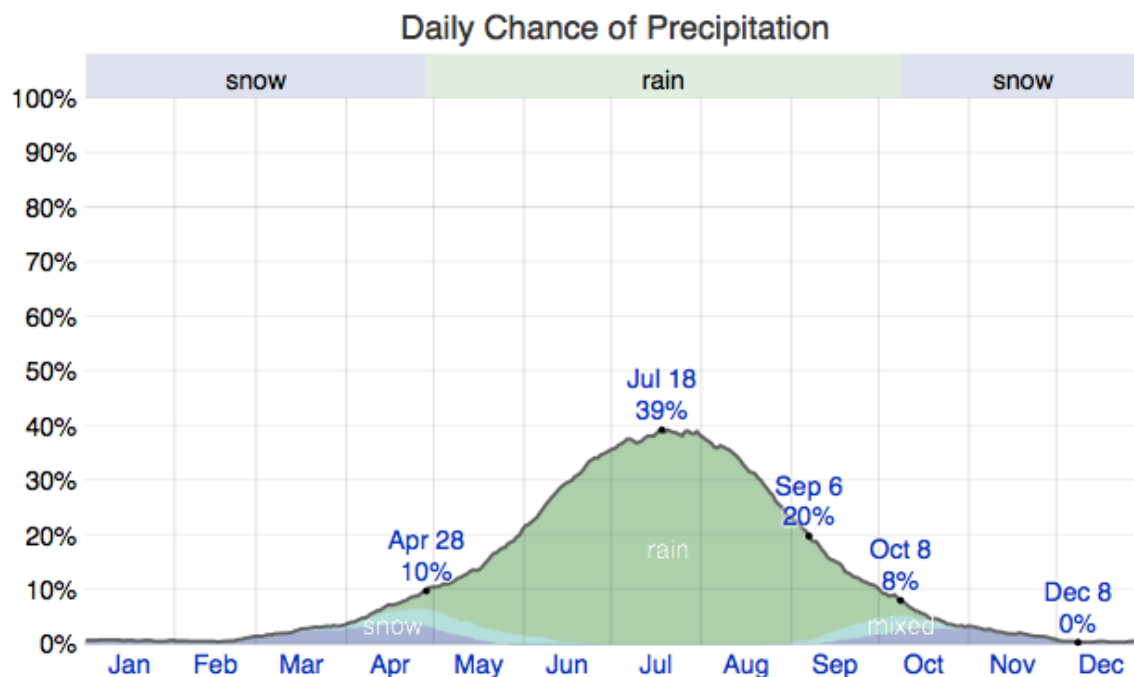
Secondly, increased wear on mining equipment. If emissions were too high, production schedule may be curtailed and fines can be imposed. A proper dust protection system can offer reliable operations and ease of maintenance. Thirdly, concerns about convenience from mine site dust often relate to visibility of dust plumes and dust sources. Fourthly, dust explosions have potential for causing catastrophic harm to personnel and facilities. Thus, prevention of fire and dust explosions hazard when manufacturing, processing, and handling of combustible particle explosion operation required. Significance of dust effect needs quality control of mine environment to controlling the dust particle's possible results.

### 1.3 Influences on dust formation in mining

There are 2 different possible factors that affect arising dust pollution in the Erdenet city. In urbanized environment mining fine dust waste need to prevent from arising and make a cause to near surrounding area. Mongolia itself located at high elevation, with a cold and predominately dry climate condition. It has a low amount of precipitation and high temperature fluctuations. Water resources are limited and unevenly distributed within the landlocked nation. Climate conditions and lack of water sources issues described below.

**Climate:** Mongolia is one of the most vulnerable to climate change countries in the world because of its specific geographical and climate conditions. Impacts of particular weather conditions associated risks like mining industries. It has a very dry climate with extreme and widely fluctuating inland, with temperatures and low rainfall due to locating high altitude. Average annual temperatures are around 8,5C in the Gobi and -7,8C in the high mountainous areas. The extreme minimum temperature is -31,1C to -55,3C in January and the extreme maximum temperature is +28,5C to +44,0C in July. The annual precipitation amount is averaging 200-220 mm, ranging from 38,4 mm in the south (Gobi desert region) to 389 mm in limited areas in the north. About 90.1% of precipitation evaporates, only 9.9% forms surface runoff, partially recharging into ground water aquifers. Most precipitation occurs in June, July and August; the driest months are from November to March. Unfortunately in the last 60 years, the average yearly temperature has warmed by 1,9C, while the annual precipitation has fallen down by about 10%.

The drier season lasts 8,7 months, ranging between beginning of September to end of May. On the other hand drier season lasts 3,2 months, from end of May to beginning of September, with a greater than 20% chance of a given day being a wet day. Highest chance of wet day reaches 39% on middle of July. Among the rather short wet days distinguished into snow only, rain only and snow and rain both. Based on this assumption, snow alone lasts 6,7 months, from beginning of October to end of April. Average chances of snow only days have 5%. Rain alone season lasts 5,4 months, ranges between end of April to beginning of October see Figure 1.



**Figure 1** The percentage of days in which various types of precipitation are observed, excluding trace quantities: rain alone, snow alone, and mixed (both rain and snow fell in the same day).

Rainy period of the year lasts about 4,6 months, from beginning of May to end of September, with daily rainfall at least 1,27 cm. Highest rainfall reaches with an average total accumulation of 7,11 cm in around end of July. Rest 7,5 months between end of September to beginning of May express rainless terms see Figure 2.

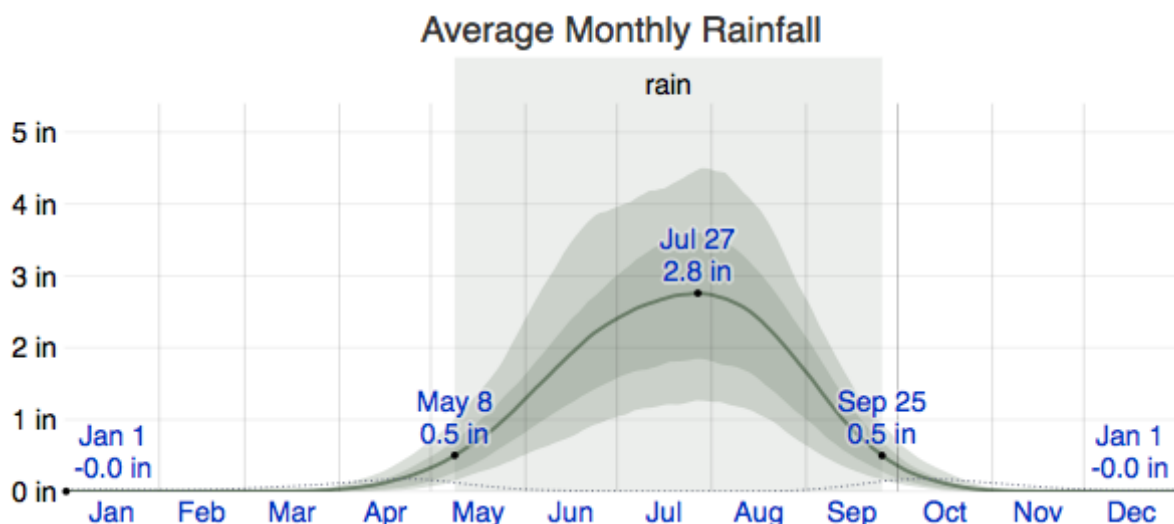


Figure 2 The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25<sup>th</sup> to 75<sup>th</sup> and 10<sup>th</sup> to 90<sup>th</sup> percentile bands. The thin dotted line is the corresponding average liquid-equivalent snowfall.

Figure 3 shows the average annual rate of change in total snowfall. Among the figure, the average shows extremely low snowfall observations 0,5 cm during the year.

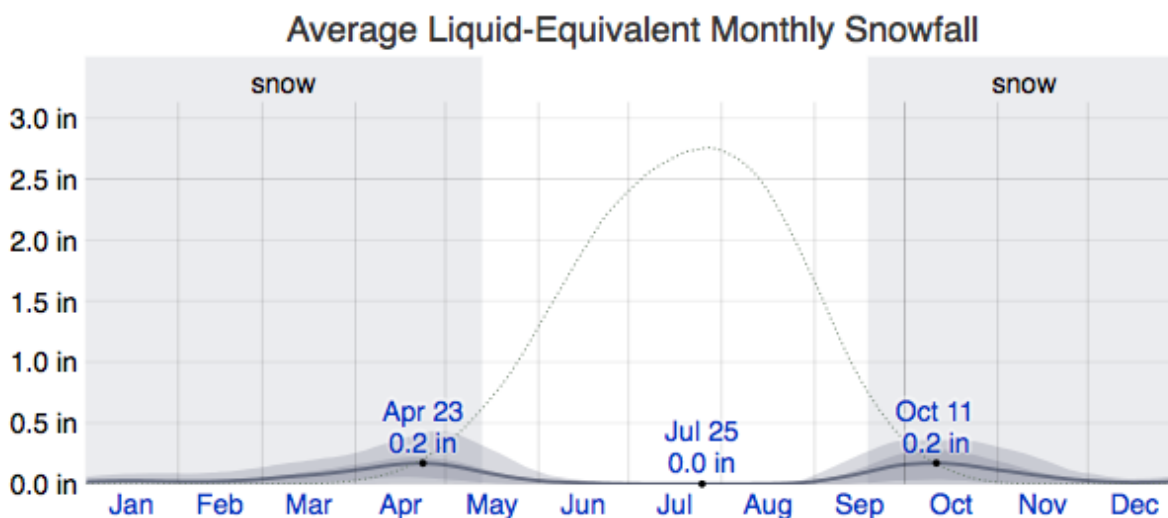


Figure 3 The average liquid-equivalent snowfall (solid line) accumulated over the course of a sliding 31-fay period centered on the day in question, with 25<sup>th</sup> to 75<sup>th</sup> and 10<sup>th</sup> to 90<sup>th</sup> percentile bands. The thin dotted line is the corresponding average rainfall.

Another important factor is a wind, which lasts for 7,4 months ranged between end of October to beginning of June, and the average wind speeds of more than 13,35 kilometer per hour. The calmer time of the year lasts for 4,6 months, from beginning of June to end of October (2). Annual average metereological condition in Erdenet city shown in Figure 4.

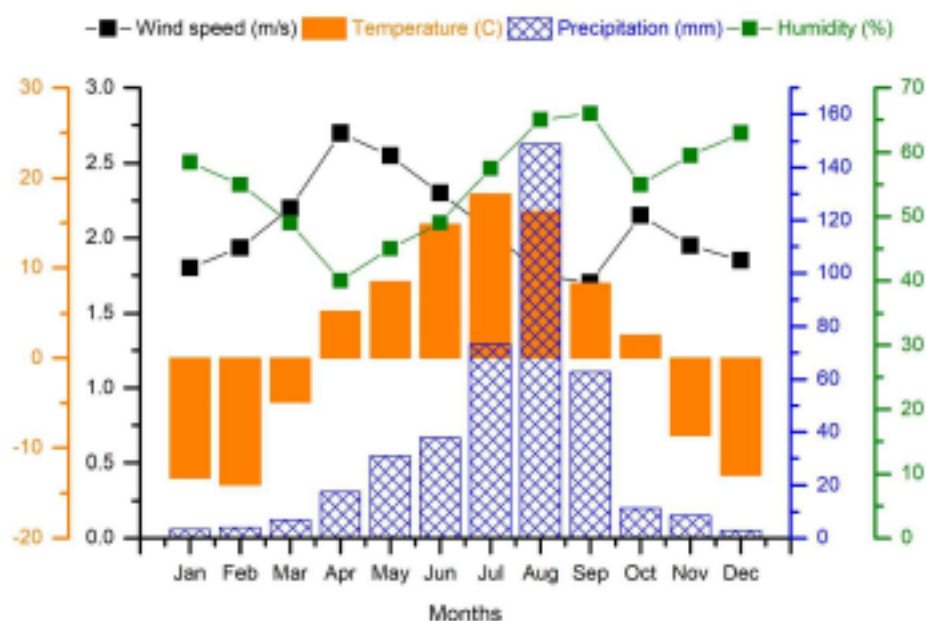


Figure 4: Monthly average meteorological condition in Erdenet city (3)

**Water resources (Geology):** The total surface of Mongolia is estimated as 608,3 km<sup>3</sup>/year (4) and is composed mainly from water stored intakes 500 km<sup>3</sup>/year and glaciers 62,9 km<sup>3</sup>/year. The long-term average annual renewable water resources include 32,7 km<sup>3</sup> of surface water and 6,1 km<sup>3</sup> of groundwater. Total of resources of potential consumption 15,75 km<sup>3</sup>, of which surface water resource 4,96 km<sup>3</sup> and underground water resource 10,797 km<sup>3</sup>. Total ground water resources estimated at 10,79 km<sup>3</sup>/year. Mongolia has 5121 rivers, 9340 streams and creeks, 3732 lakes and 262 glaciers in total. In the desert zone's 76,6% of the territory and there are do not have permanent-flown rivers or streams. The supply of water is directly affected by weather and climate. Lack of water resources caused by a combination of poor drainage and high evaporation rates. Critical water use is a seasonal due to freezing and droughts limit the use of water resources in Mongolia. Expanding mining and industrial activities, urbanization and intensified land-use for agriculture increasingly endangers groundwater quality in Mongolia. Since Mongolia has a lack of water sources then try to use it reuse and reduce the amount of water and get maximum productivity. If not these changes generally increase the operational challenges and risk for the water sector.

**Technology:** Dust is generated in mining by turbulent action of wind in combination with mechanical actions like blasting, handling and transporting stages.

## **1.4 Mining in Mongolia**

Mongolia is the fortunate position of having the resources support. The mining industry is central to Mongolia's economic sector. The mining industry's output is largely based on copper and gold from two leading mines Oyu tolgoi LLC and Erdenet Mining Corporation (EMC). Impact of EMC is hugely contributed to economy but at the same time it is a powerful source of negative impacts on humans and environment. Issues related to the assessment of this impact are the subject of a study of mining generated dust. The degraded area is growing year to year. The development of strip mines and the deposition of overburden, spills and tailings all degrade land resources. Domestic and industrial construction and other forms of waste are currently deposited on the soil surface in overly large, designated dumping sites on the outskirts of cities and towns. The tailing pond's waste clay turns into a very fine dust by drying up by sun and wind. The residents of Erdenet are concerned by the possible negative impacts of the health. Thus, the dust pollution needs to be reduced as soon as possible to acceptable amount. Thus, the large volumes of waste produced, mining activities must shift their focus from metals extraction and recovery to long-term management and monitoring of waste materials.

## **1.5 Technical opportunity to water separator**

Mining waste is a major environmental issue Mongolia is facing today. Dust, which results in a serious hazard with respect to the environment and to personal health and safety. The objective of this thesis is to reduce the amount of dust emissions on mine surfaces by using regenerative dust-binding reagents based on industrial production residue. The development of dust binders based on waste produced in the Mongolian industry could results in the possibility of economic recycling of wastes and reduction of waste production in the relevant industry. On this assumption this study is to dust preventions and dust suppressions made of by sprinkled aqueous industrial waste liquids. Based on wastes from Mongolian livestock farms to get reagents, which reduce surface dust problem. At the best, affordable, nontoxic dust suppressants should be developed and used to reduce surface dust issues.

## **1.6 Objective of study**

Since mining operation causes dust formation. To preventing this situation dust suppressions with the sprinkled liquids in mining can be possible solution. However the use of water, which is rare resource in Mongolia, must be kept as low as possible. Unfortunately, the use of water is problematic in the winter months as it is on can freeze the street; in the summer months keeps the desired effect often only for a short period of time, as the water evaporates too quickly. Thus situation can be made possible by the use of aqueous industrial waste liquids. Mongolian industrial residues identified by their low freezing point, can be used in

winter another positive feature is their hygroscopic effect. They can deprive the air of moisture and thus evaporation delay. Quantitative analysis of residues of industrial waste generated in according to the list of possible questions. Based on these characteristics to investigate the Mongolian industry regarding kind and masses of liquid waste generation with the content of its disposal.

The selected reagents and the corresponding application concepts are tested on the samples in laboratory scale. Promising liquid should be large scale tested at mine site in EMC. Field tests done in EMC from 5<sup>th</sup> October to 1<sup>st</sup> of November by used hydroscopic substances wool, water and milk, which produced in large amount of wastes from Mongolian livestock farming.

After selected liquid reagents done in practical experiments in laboratory and in field tests results will analysed general estimation of effectiveness and the practicability of the investigated liquids.

## 2 State of art

### 2.1 Fundamentals of Mine dust pollution

#### 2.1.1 Definitions of dust

The dust defined as “Finely divided solids that may become airborne from the original state without any chemical or physical change other than fracture” by the Mine Safety and Health Administration (MSHA). "Dust" is a collective term for finest solid particles of different sizes and different origins, which can remain for a period in the air (5). Simply “Dust” is commonly known as tiny solid particles that are carried by air current and origins from disintegration or fracture process.

#### 2.1.2 Origin of dust in mining discipline

Mining dust is formed whenever rock is broken by impact, abrasion, crushing, cutting, grinding, drilling, blasting, excavating, loading and tipping, transporting, crushing, conveying and screening, stockpiling, bagging or the use of explosives. In addition, the emission of dust may result of a change in turbulent action of wind.

Almost all aspect of work in mining are a source of dust. A primary concern is one that produces. A secondary concern is disperses of dust.

Origin of dust in mining discipline shown in Table 1.

**Table 1: Origin of mine dust list**

<b>Main dust sources in Surface Mining</b>	<b>Generation of Dust in Underground Mining</b>
primary crusher	Blasting/drilling
discharge points	Loading/breaking
dry screens	Conveying
return strand of conveyer belts	Crushing
dump hopper	
transfer points	
stockpiles (open and enclosed)	
dry loading areas	

Origin and composition of particulate matter are very different. In general, a distinction is made between natural and anthropogenic sources as well as primary and secondary release. The terms primary and secondary refer to both natural and anthropogenic sources. Primary means that the fine dust was released directly by a process. By secondary origin chemical

transformation processes or the addition of particles to gaseous precursors are understood. Classification of source of dust in underground mines listed in Table 2.

**Table 2: Classification of Source of dust in underground mines**

<b>Operation</b>	<b>Primary</b>	<b>Secondary</b>
Blasting	+	+
Cutting, continuous mining	+	-
Drawing chutes	-	+
Drilling	+	0
Mucking, loading	-	+
Blowing holes	0	+
Dumping cars	-	+
Slushing	-	+
Belt transfer, discharging	0	-
Haulage	0	-
Timbering	0	-
Scaling	0	-
+ denotes a major source, - denotes a minor source, 0 denotes a negligible source		

### 2.1.3 Classification of dust

Dust particles size varies from over 1 mm to less than 1 µm. The particle size effect their sedimentation behaviour shows in Table 3:

**Table 3: Particle size influence of thier sedimentation behaviour**

<b>Particle size</b>	<b>Behaviour</b>
>10 µm	Settle according to the law of gravity
0.1 - 10 µm	Suspends in still air but settles at a constant Velocity according to Stoke's law
0.01 - 0.1 µm	Do not settle but diffuse in the air and remain in A colloidal (suspended) state

Natural dust generally ranges in sizes greater than 40 µm. Mine dust is finer than natural dust , ranges in sizes 76 % < 1 µm, 20 % between 1 µm and 4 µm, and 4 % > 4 µm (6).

### 2.1.4 Types of dust

Dust is classified by size into two primary categories:

1. Inhalable dust ( $> 10 \mu\text{m}$ ) =  $> \text{PM}_{10}$  (Particulate matter)
2. Respirable dust ( $< 10 \mu\text{m}$ ) =  $< \text{PM}_{10}$  (Particulate matter)

Coarse particles ( $> 2.5 \mu\text{m}$ )

Fine particles ( $2.5 - 1 \mu\text{m}$ )

Ultrafine particles ( $< 1 \mu\text{m}$ )

Inhalable dust defines "Size fraction of dust which enters the body, but is trapped in the nose, throat, and upper respiratory tract" by U.S. Environmental Protection Agency (EPA) (7).

Respirable dust small enough to enters the human body thereby penetrate the nose, upper respiratory system and gets deep into the lungs.

Inhalable dust and respirable dust makes up the total dust.

### 2.1.5 Generation of dust on mining

Mining dust is formed whenever rock is broken by impact, abrasion, crushing, cutting, grinding, drilling, blasting, excavating, loading and tipping, transporting, crushing, conveying and screening, stockpiling, bagging or the use of explosives. In addition, the emission of dust may result of a change in turbulent action of wind.

Almost all aspect of work in mining are a source of dust. A primary concern is one that produces. A secondary concern is disperses of dust.

### 2.1.6 Problems related to dust

Dust in mining area has various impact on humans and environment. The effect mine dust has on the human body mainly depends on five factors.

1. Dust composition (chemical or mineralogical)
2. Dust concentration in  $\text{mg}/\text{m}^3$
3. Particle size and shape
4. Individuals susceptibility (e.g. allergy)
5. Exposure time

Those main factors to determine the effect dust may have on occupational health.

Most common health diseases of dust (lung disease, pneumoconiosis and silicosis) over a certain period of time.

**Lung decease:** caused by the inhalation of dust

**Pneumoconiosis:** is an occupational lung disease caused by over sufficient long periods of time coal workers inhalation of dust.

**Silicosis:** is one of the dangerous diseases, which caused by crystalline silica from quartz, sandstone and flint. Produced in mining operation and sandblasting.

## 2.2 Influences on dust formation in general

Important influences can give effect of dust.

- Size and weight of particles, which smaller and lighter and larger the surface area relative to their mass. Particles air movement exceed downward gravitational forces.
- Climate, that depends on humidity and
- Geology, that can water availability
- Technology, which method used in process and transportation of material and handling.
- Tonnages of material

## 2.3 Dust control

Environmental Law Alliance Worldwide defines “Mining can contaminate soils over a large area, and mining activities can generate human health and environmental risks from contaminated soils, which result from windblown dust and chemical spills and residues”. Due to spread of dust, that urgently require dust control system. For an existing mine, one may think of four possible methods to control the production, concentration as well as the hazards of airborne dust (6).

- Dust suppression is the prevention of dust becoming airborne.
- Once the dust has already become airborne filtration and scrubbing is a possible way to remove it from the mine air.
- If neither suppression nor filtration and scrubbing are possible or were found not to be effective for a certain size range, dilution by air flow can significantly reduce dust concentrations.
- For further separation of personnel and dust any kind of isolation/separation of personnel and dust may be applicable.

In this study focused on dust suppression Water is most common used method to dust suppression or dust filtration. Two parameters are of great importance: the size of the water droplets and the water-to-air ratio.

## 2.4 Dust measurement

Assessment of Meteorological measurements essential to collect data. Further quantities to be measured historically.

Wind speed and wind direction measurements: for evaluation of dust spread concentrate on distribution of wind speed, wind occurrence, wind direction and velocity.

Turbulence parameters: which are affected by the horizontal wind direction and vertical wind speed fluctuations.

Air temperature, that is a measure of temperature at different levels. It is the most commonly measured weather parameter.

Air humidity: depends on water vaporization and condensation.

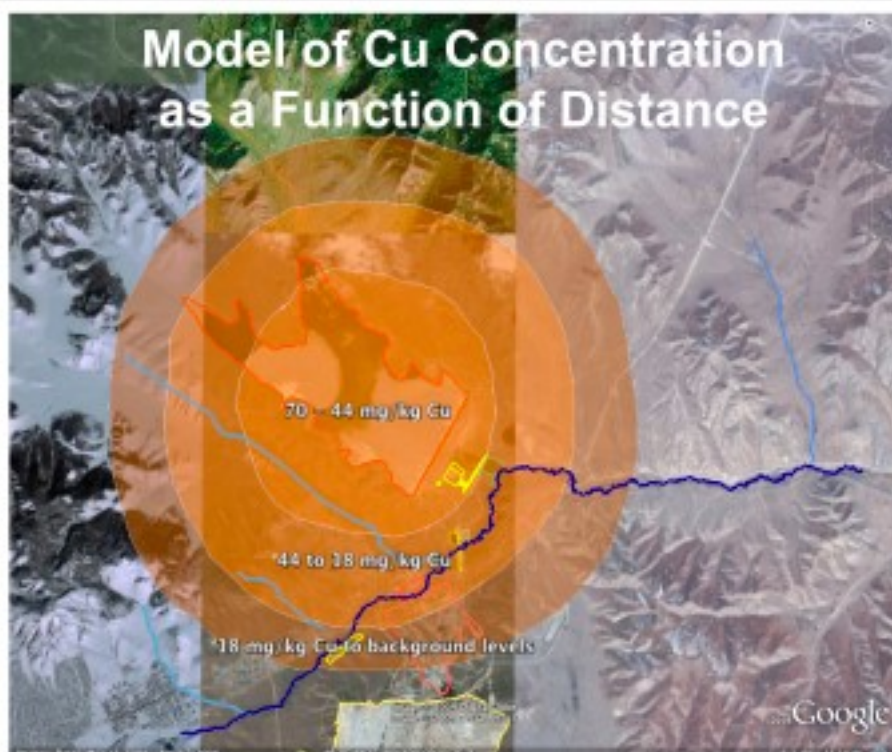
Precipitation measurements: measure total amount of precipitation (rain and snow), which measure the amount of liquid precipitation over a set period of time.

## 2.5 Dust related literature of study area

While the problem of dust formation in Mongolia has been extensively covered in the literature (8), (9) there are no relevant publications dealing with the topic of dust binding in Mongolia.

The EMC mine is expected to continue operations for at least another 30 years due to the availability of new innovative technology and machineries (10). Therefore, environmental problems related to the mining activities should be addressed and properly evaluated with appropriate countermeasures put into place. Subsequently, this study was initiated to assess the present conditions of the soil and water environment in the Erdenet area to evaluate the potential liquid solutions for sprinkler to mining activities on the environment.

In 2008, white sands samples from tailing ponds analyzed by atomic absorption (AA) flame technique following U.S. Environmental Protection Agency Method 3050. This method dissolve almost all elements that using strong acid digestion. Metals in the sediment samples also were analyzed by x-ray florescence. Chromium (Cr) 13.1mg/kg, arsenic (As) from 9.3 mg/kg, lead (Pb) from 2.3 mg/kg, and copper (Cu) from 2.7 96.1 mg/kg were detected in tailing pond samples. According to this study the influence of mine tailings by wind on the Erdenet area is shown in **Error! Reference source not found.**. The model shows copper concentrations are highest near the mine (70 – 44 mg/kg), at moderate levels (44 – 18 mg/kg), and decrease from 18 mg/kg to background levels in the Erdenet industrial area (8).



**Photo 1: Google Earth image showing the influence of mine tailings in the Erdenet area**

According to study in 2015 white dust was spread between 14 and 65 km. White dust distribution would increase up to 38 km in May to 68 km in October. Experiment compared the white dust dispersion to weather factor, it is related to precipitation, relative humidity and wind speed. Figure 5, simulations were shown determination of dispersion of white dust and motion direction of the dust plume over tailing pond. (9).

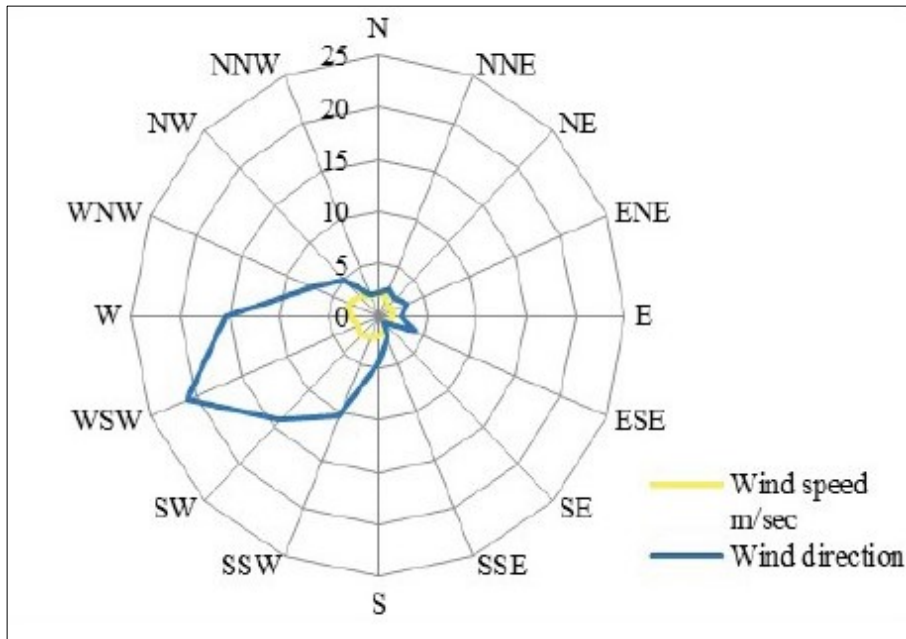


Figure 5: Polar graph showing the relative impact of the wind, according to azimuth

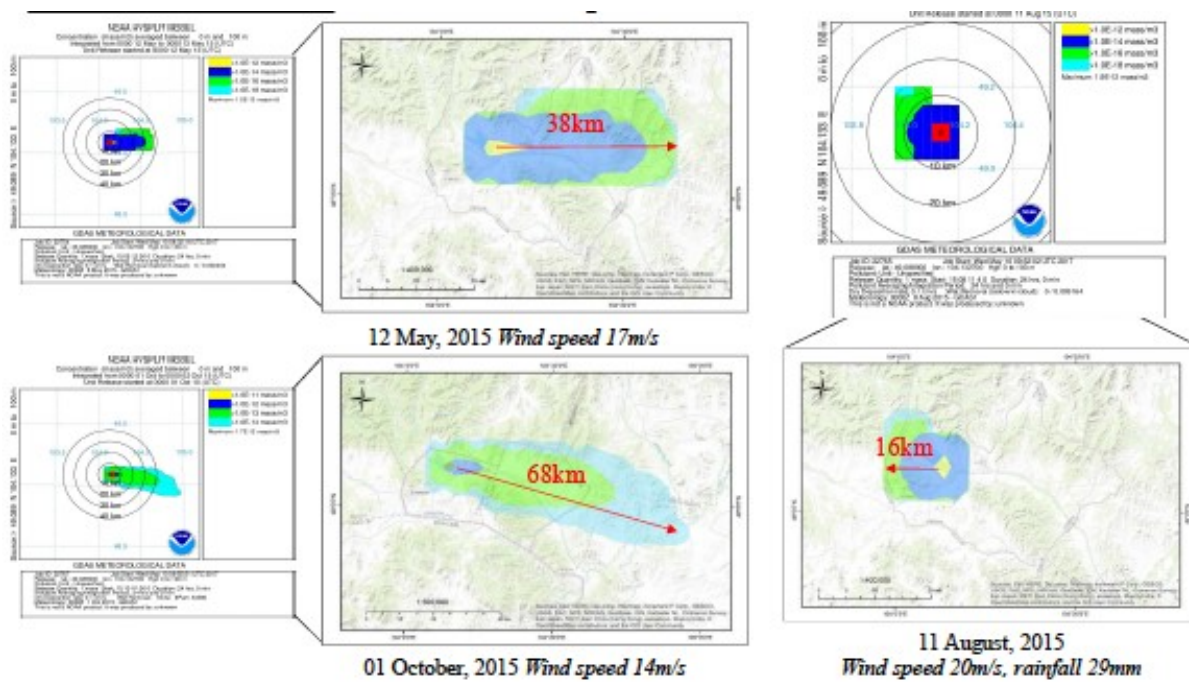


Figure 6: White dust dispersion



Photo 2: White dust disturbance in wind speed of 17m/s

Figure 6 shows difference between rainy day and normal day of wind distribution. And **Error! Reference source not found.** shows dust distribution's photo.

From the analysis between rainy day and normal day, white dust distribution was four times lower when the rainy day. As reported by precipitation is important indicator that white dust spread and suggested that the rainfall might be one of the solutions for the distributions of dust.

In April, Erdenet city's citizen's representative (Иргэдийн Төлөөлөгчийн Хурал) meeting convened and discussed the "White dust" program implemented in 2019-2022. The program aims to assess the impact of white dust and ecological health, to implement mitigation measures, reduce ecological adverse impacts, to conduct preventive health checks and to disseminate accurate information to citizens (11). In order to reduce the White Dust program, two Road Belas from the Auto Transportation Department are spraying on the tailings area with 320 tons of water every day (12).

## 2.6 Composition of tailing dump

The summary of the mineral elements of the tailings is set out in Table 4. Chemical contents of the tailing dump shows in Table 5.

**Table 4: Composition of element material and elements**

Waste Material		Waste Characteristics	
Mineral	Minerals content,%	Element	The contents of the element
Chalcocite	0.065	Cu, %	0.15
Covellite	0.062	Fe, %	2.26
Chalcopyrite	0.063	S, %	2.39
Borne	0.003	Mo, %	0.009
Tensantite	0.008	Zn, %	0.002
Copper oxide mineral	0.046	Pb, %	0.001
Molybdenite	0.015	As, %	0.003
Pyrite	4.35	Ag, g/ton	0.71
Iron Oxides	0.3	Au, g/ton	0.006
Quartz	38.5	Pt, g/ton	0.002
Plagioclase	29.5	Re, g/ton	0.12
Sericite	27	Se, g/ton	2.53
Total	99.92	Te, g/ton	0.58
		Bi, g/ton	1.05
		Ni, g/ton	2.51
		Co, g/ton	10.04
		Cd, g/ton	0.32
		Hg, g/ton	0.89
		Ga, g/ton	20.58

**Table 5: General chemical composition of tailing dump**

Cu	0.55-0.65
Fe	2.4-3.3
Mo	0.019
S	2.4-5.5
Al <sub>2</sub> O <sub>3</sub>	13.9-16.3
MgO	0.5-1.18
CaO	0.1-0.3
SiO <sub>2</sub>	0.62-0.69

Physical characterization of disposal by granulometric analysis, which determines the particle composition in sediment samples. The granulometric analysis of the sample taken from 61 points (October 2, 2015) in Table 6.

**Table 6: Granulometric analysis result**

Size (mm)	% weight retained (%)
+ 0,212	6.44
-0,212 + 0,15	9.75
-0,15 +0,106	10.04
-0,106 + 0,075	10.25
- 0,075+ 0,045	10.66
-0.045	52.86
Total	100%

- Waste yield = 97.93%
- Weight from waste dump - 1.24-1.4 g / cm<sup>3</sup>
- Average weight of tailings - 2.62 g / cm<sup>3</sup>
- Granulometric analysis:

The granulometric analysis of the sample taken from 61 points (October 2, 2015) (3).

Concentration of heavy metals in the white dust.

Based on (3) , shown in **Error! Reference source not found.** the amount of water required for the irrigation was calculated. Tailings pond's dried part is 1347.7 ha. The minimum moisture content of white dust is 5 percent and 23000 m<sup>3</sup> water per day is required to calculate the amount of water required for the total area. Thus, need to find the affordable disposal supply to determine this study.

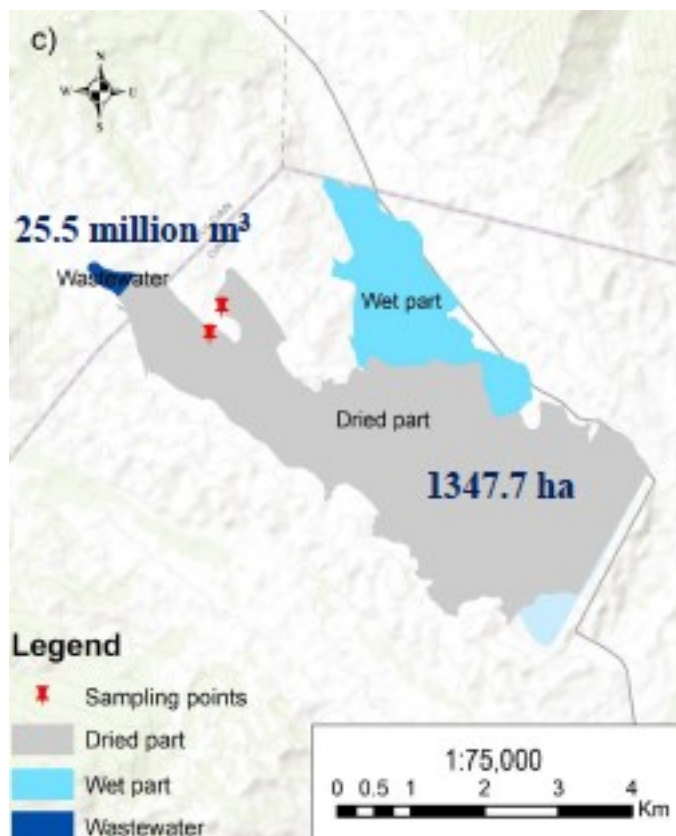


Photo 3: Satellite photo of Tailing dump in EMC

## 2.7 Surfactant type

Different surfactant types act differently in modifying the characteristic of water solution, thus perform differently when applied to water spray systems for dust control. The choice of the surfactant type is the primary factor to consider for improved dust suppression. A variety of surfactants were investigated in order to determine the most effective ones in terms of efficiency, availability and cost. Based on Mongolian availability, identification of waste liquid done firstly.

## 2.8 Surfactant evaluation methods

To find appropriate production concepts and method for applying the dust binder are defined through laboratory tests and field tests. Suggested laboratory test on surfactant method in static tests such as capillary rise test and drop penetration test are commonly to express wettability. Dust concentration reduction tested in dynamic tests such as wind tunnel test and field test (13).

Capillary rise test is the oldest method used for surface tension determination. This test determines the capillary absorption behavior of hardened by metric methods. The absorption of water hardened sample should correspond to that of the material being crowded to ensure compatibility of original material.

Drop penetration test determines wettability of material. Measures the penetration rate of surfactant solutions into powders due to gravity. In general, the less penetration time and the larger wetted area, the better the wetting performance surfactants possess

Wind tunnel test and field test both determine dust concentration reduction. Wind tunnel test carried out in laboratory, which provide a controlled environment where the tests can be performed easily and economically Generally, such system includes a wind tunnel to confine the spread of dust, a blowing or exhausting fan to provide air flow, a dust feeder to introduce dust particles into the wind tunnel, the water spray apparatus, the dust monitoring equipment, and a tail dust collection unit.

Field test is the most direct way of evaluating the effectiveness of coal dust control because it is conducted under the real working conditions where coal dust need to be suppressed. However, it is challenging due to multiple nature interacting phenomena.

## 2.9 Surfactant type

SDS (anionic), CTAB (cationic) and Octylphenol Ethoxylate (Triton X-100) (nonionic) are the most studied surfactants in wettability. The degree of wettability changes mainly depend on the type and adsorption characteristic of surfactants. Wettability is determined by the surface hydrophilic sites and hydrophobic sites, which can be modified by the adsorption of surfactants. Nonionic surfactant is considered to be ideal candidate because of highest efficiency in wettability (13). Following three surfactand: coarse wool, milk, liquid whey surfactant composition described below.

Wool is made up of amino acids, many of which have acidic and basic side chains, conferring good ion exchange properties. According to study (14) has developed methods for modifying some of side chains can absorb specific heavy metals such as arsenic, zinc, copper, chromium, etc. The metal absorbing properties can be exploited using native coarse wool.

Milk is mainly water (around 80 percent) but it does contain a reasonable amount of fat which is hydrophobic and won't mix with water. However, the amount of fat is quite small and something like 2% milk should mix pretty well with water in hydrophilic. In Table 7 comparison of gross composition of milk from different species of mammals (15).

**Table 7: Gross composition of milk from different-species of mammals**

Species	Scientific name	COMPOSITION (g/100g)					
		Water	Fat	Casein	Whey proteins	Lactose	Ash
Human	<i>Homo sapiens</i>	87.1	4.5	0.4	0.5	7.1	0.2
Cow	<i>Bos Taurus</i>	87.3	3.9	2.6	0.6	4.6	0.7
Zebu	<i>Bos indicus</i>	86.5	4.7	2.6	0.6	4.7	0.7
Buffalo	<i>Bubalus bubalis</i>	82.8	7.4	3.2	0.6	4.8	0.8
Goat	<i>Capr hircus</i>	86.7	4.5	2.6	0.6	4.3	0.8
Sheep	<i>Ovis aries</i>	82.0	7.2	3.9	0.7	4.8	0.9
Horse	<i>Equus caballus</i>	88.8	1.9	1.3	1.2	6.2	0.5
Camel	<i>Camelus dromedaries</i>	86.5	4.0	2.7	0.9	5.0	0.8

Liquid whey, the watery component of milk removed from the curd in cheese manufacture. Consists primarily of water (93 %), lactose, and whey proteins. Milk is rich in protein content and has a unique protein namely the casein. It is present in the form of colloidal dispersion in milk and is responsible for several physical properties of milk. It also supplies all the essential amino acids, hence a complete protein and easily digestible. In addition to casein, milk also contains (other) proteins which are known as whey proteins. Solubility of proteins relates to surface hydrophobic (protein-protein) and hydrophilic (protein-solvent) interaction; in food case, such solvent is the water, and therefore the protein solubility is classified as a hydrophilic property (16).

In Table 8, shows visvosity of water, liquid whey, and various types of milk. Liquied whey's viscosuity is as similar as water.

**Table 8: Viscosity of water, whey and various types of milk**

Type of Milk	Viscosity (centipoise)
Water	1
Liquid whey	1.2
Skim Milk	1.5
Whole milk	2.0

### 3 Material and methods

#### 3.1 Laboratory test on samples

Dust generally consists of suspended solid particles, which are difficult to bind with water because of their lightweight and small size (11). Thus measuring different samples can give better reagent.

Carrying out simple laboratory and field tests and simple laboratory tests to first determine liquids (viscosity ,vapor pressure). Viscosity is a measure of the resistance of a fluid which is being deformed by either shear stress or tensile stress. In everyday terms (and for fluids only), viscosity is "thickness" or "internal friction". Thus, water is "thin", having a lower viscosity, while honey is "thick", having a higher viscosity. Put simply, the less viscous the fluid is, the greater its ease of movement (fluidity) (17).

Took aqueuous samples from diiferent industries (wool and milk production) **Error! Reference source not found.** to viscosity test in 30 rpm and 60 rpm experiment **Error! Reference source not found.** check internal flow resistance of samples see Table 9 Erdenet textile's waste water's viscosity was highest among all others. Rest of values are quite stable. Liquids with high viscosity resist shearing motions more strongly than liquids with low viscosity. That is, low viscosity liquids are more runny.

**Table 9: Viscosity of different liquid wastes**

	Name of Industry	Sample source	Speed	Data
			Rpm	mPa*s
1	Tuya Cashmere	Sample	60	2
2	Loropiono cashmere	Waste water	60	2
			30	0.8
3	Teso LLC /Teso LLC /Milko//	Filtered water	60	2
			30	1
4	NTG /Erdenet Textile/	Waste water	60	3
			30	1
5	EMC LLC	Waste from flotation process	60	2
			30	1



Photo 4: Aqueous samples



Photo 5: Viscosity test

### 3.2 Passive dust samples (PDS)

In the field test carried out Passive Dust Sampler (PDS) test. A passive particle monitor measures particles without the use of mechanical or electrical systems, depending instead on natural wind-blown deposition of particles on a collection surface. PDS is easy to setup in field and low costs requires. It can work without electricity and most importantly collect actual particles (18).

### 3.3 Identification of Mongolian waste liquids:

Agriculture provides 14,5 percent of its gross domestic product (GDP) in 2013. This makes it the third largest contributor to GDP after retail (17,7 percent) and mining (16,6 percent) in 2014. The high market value based on herder productions such as wool and cashmere; and milk

Mongolian industry and their residues for dust binding are being developed on Mongolian mine. Biggest wool and cashmere; milk and dairy product industry Quantitative analysis of residues of industrial waste generated in according to the list of possible questions. Detailed information on how each plant's wastes comes from and amount of residue is on the survey. Table 10 shows the questionnaire.

**Table 10: Questionnaire for gather data**

Questionnaire		Answer
	Name of industry	
	Contact person information	Name
		Phone
		E-mail
1	What kind of production produced?	
2	Where is the location of waste producer?	
3	Main source of waste?	
4	What kind of waste standards are followed?	
5	What is the composition of waste type? (organic/inorganic, hazardous waste, textile)	
6	What is the waste type? (solid, liquid)	
7	Amount of solid/liquid wastes production	
8	Do you collect your solid/liquid wastes separately? If yes, how?	
9	How is the waste disposed of?	
10	Is the waste recycled or reused?	
11	Amount of solid wastes reclamation	
12	Any contractor companies for waste/disposal?	
13	Amount of solid wastes disposal	
14	How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	
15	How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	
16	Cost of disposal?	
17	Any revenue obtained by the produced waste/ recycled or reused?	
18	Is there any tracking action done on the waste disposal system or location	
19	How much waste/disposal could they give us?	
20	How much is it? Is it free?	

**Wool and cashmere:** Annual production of 33 thousand tons of wool, 9,6 thousand tons of cashmere camel, 1,7 thousand tons of camel wool, 0,3 thousand tons of yarn preparation stock. As of 2017, there are 25 processing factories in cashmere processing, combing 6,

complex technology complex 8, braiding and knitting 2, spinning and braiding 1, medium sizing braiding factory and 250 small factory in total 298 factory operation is being carried out. The estimation of over **8500 tons of Coarse wool** in the primary processing of 60 percent of the total production is estimated in Ministry of Food, Agriculture and Light Industry of Mongolia (19). Coarse wool is a pieces that are residue, when cutting process. It is often too difficult or time consuming for designers and factories to figure out how to use the leftover Coarse wool, so it is simply thrown into the garbage and hauled to the landfills. Some of clean flocks used to make small sized products.

Government of Mongolia has developed its Action Program to be implemented for the period of 2016-2020, reflecting Mongolia's Sustainable Development Vision 2030. The Government of Mongolia aims at "Increase the share of production and processing sector in total exports to up to 15 percent, wool and cashmere to up to 60 percent in the total raw material produced" (20).

The Mongolian sheep coarse Coarse wool made of traditional method of primary processing is not suitable for knitted fabrics. Therefore, have been producing carpets and felt products. It has a coarse wool consisting of cashmere fibrous, intermittent hair, sor hair, and Coarse wool hair. These flocks are not uniform, lengthy, thinner, poorly absorbed dyed and found loose hair on a final product. Goat Coarse wool size varies between 8.96- 10.4 cm (21) and average sheep Coarse wool size 5 cm (22). Consequently, the raw material could not be used as a consumer's satisfactory product, and it would not have been economically viable. Therefore wool 1 kg of coarse and coarse wool did not raise more than 100-400 MNT (23). The need for market for ecologically clean products by using residue flocks to make it profitable. Among 7 biggest wool, cashmere and carpet industries filled "Amount and types of residues of industrial waste" questionnaires. All companies use numerous amount of water for processes, furthermore used water send to central sewerage. Questionnaires questions divided into three different part by their variety. Table 11 shows amount of waste/disposal per year and how much of waste/disposal could they give out NO-Dust project with prices.

**Table 11: Questionnaires of Amount and types of residues of industrial waste**

	<b>Name of the company</b>	<b>Annual amount of waste water to clean equipment /tonn/</b>	<b>Annual amount of Sludge and clay</b>	<b>Annual waste clean Coarse wool amount /tonn/</b>	<b>Annual waste dirty Coarse wool amount /tonn/</b>	<b>Annual amount of waste/diposal could they give us?</b>	<b>Waste price per kg /Tugrik/</b>
1	NTG /ERDENET TEXTILE/		2223,63	-	20	113.0тн очёс +20.0тн лак будагтай	Negotiable
2	Mogol Noos	2096m3	7,5	23,3	23,3	ноос+шороо	Negotiable
3	Nekheesgui edlel	-	-	7	3	-	-
4	Sor cashmere	-	-	26		26,1	200-3000
5	Ulaanbaatar carpet	-	-			60-72 очёс	Free/200
6	Bayalag Ulzii	55 to 60 t per wash	450 kg per wash	10000			1500-3000
7	Eco wool	40	40	-	-	23	100

Table 12: Waste content

	Name of the company	What chemicals are in the production line?	Is it a harm to the environment ? How?	What kind of waste standards are followed?	Waste water soluble in water? (yes or no)	What is the composition of waste type? (organic/inorganic , hazardous waste, textile)?
1	NTG /ERDENET TEXTILE/	Техникийн сода Na <sub>2</sub> CO <sub>3</sub> , саван, Bematin, будгийн жигдрүүлэгч, глауберын давс, цууныхүчил, будагч бодисууд, аммиак, силикат натри, ус төрөгчийн хэт исэл, Латекс	No		No	Solid, liquid
2	Mogol Noos	lismrill ww, Monogen, НУ-1, НУ-2, Остедоль /EW/	No	Mongolian Waste Law	No	-
3	Nekheesgui edlel		No	-	No	-
4	Sor cashmere	Aisperstat, spintek, soap		-		

5	Ulaanbaatar carpet	Acidic dye, liquid soap, sulfur acid, yogurt clue		Follow Ulaanbaatar carpet LLC's environmental management regulation	No	Solid
6	Bayalag Ulzii				No	
7	Eco wool	Liquid soap, Borium salt, Soda	No	-	No	Solid, liquid

**Table 13: How waste ends**

	Name of the company	Do you collect your solid/liquid wastes separately? If yes, how?	Any contractor companies for waste/disposal?	How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	Cost of disposal?	Any revenue obtained by the produced waste/ recycled or reused?
1	NTG /ERDENET TEXTILE/		Landscaping service company	None	Landscaping service company		
2	Mogol Noos	Collect solid wastes to specific location. Wastewater is supplied to the central wastewater treatment facility.	None	None	Collect temporary location, where Soum's governer gave	-	None
3	Nekheesgui edlel	Collect solid wastes to use other things	Landscaping service company	-	-	80000	-

	Name of the company	Do you collect your solid/liquid wastes separately? If yes, how?	Any contractor companies for waste/disposal?	How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	Cost of disposal?	Any revenue obtained by the produced waste/ recycled or reused?
4	Sor cashmere	Collect solid wastes to sell and send landscaping service company. Wastewater is supplied to the central wastewater treatment facility.sewege center	Landscaping service company	97%	Landscaping service company	2100000	5220000
5	Ulaanbaatar carpet	Collect solid wastes to sell and send landscaping service company.	Landscaping service company	50%	Landscaping service company	-	540
6	Bayalag Ulzii						

	Name of the company	Do you collect your solid/liquid wastes separately? If yes, how?	Any contractor companies for waste/disposal?	How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	Cost of disposal?	Any revenue obtained by the produced waste/ recycled or reused?
7	Eco wool	Solid wastes are contracted with local municipalities. Wastewater is supplied to the central wastewater treatment facility.		None			None

Solid wastes from NTG /Erdenet textile/ shown in **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**



Photo 6: Solid wastes /очёс, Droppet to the landfill/ from NTG /Erdenet textile/

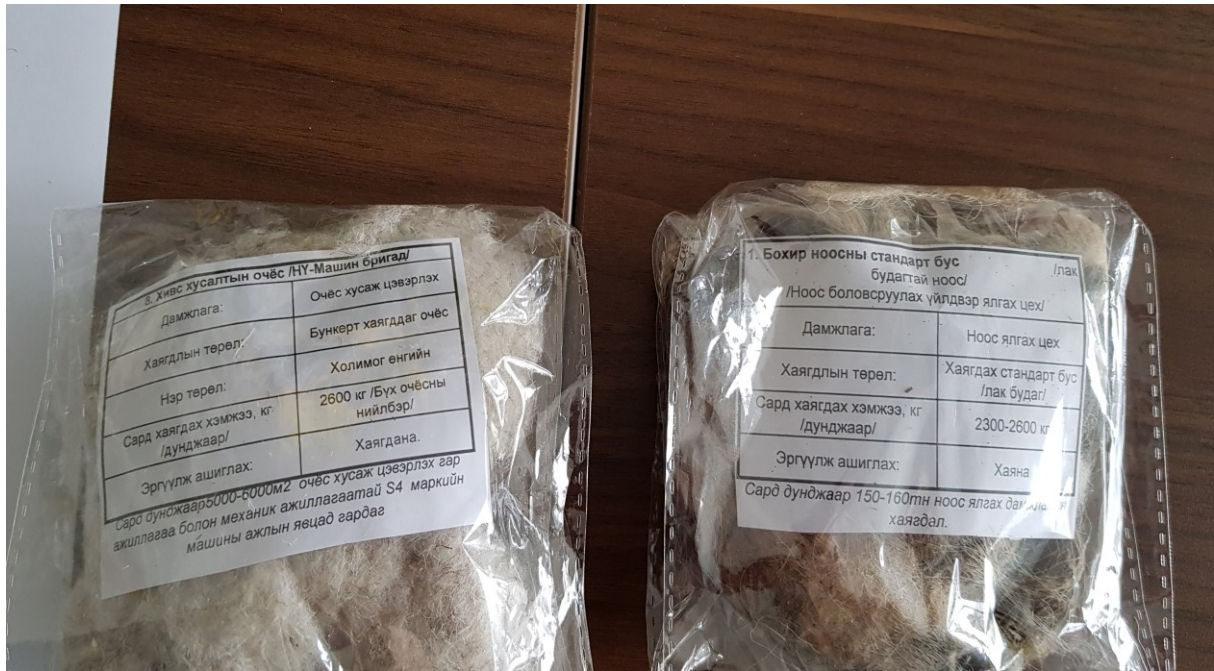


Photo 7: Solid wastes / Droppet to the landfil, painted wastes/ from NTG /Erdenet textile/



Photo 8: Solid wastes / очёс / from NTG /Erdenet textile/



Photo 9: Solid wastes / очёс, маажуур / from NTG /Erdenet textile/

**Milk and dairy products:** Production of processed milk and dairy products is estimated at 86.6 million liters per 2017. By 2018, 93.0 million liters of milk and dairy products were processed. It has increased by 10.0% compared to the same period of 2017. There are 235 milk and dairy products in Mongolia. The capacity of the milk processing industry is 928 million liters per year, with capacity utilizing 8-10 percent.(24). Due to availability of milk source it can be one possible reagent for dust binders. Another possible solution to binding dust is liquid whey, which is the liquid remaining after milk has been curdled and strained. It is a by-product of the manufacture of dairy products such as cheese or casein. Selected five biggest milk and dairy production industries filled questionnaires to find amount of residue.

Table 14: Questionnaires of Amount and types of residues of milk industry

	Name of the company	Annual amount of waste water to clean equipment /ton/	Annual waste liquid amount /ton/ whey	Annual amount of waste/disposal could they give us?	Waste price per kg /Tugrik/
1	APU dairy		per ton 400-500	Can not	-

			liter		
2	Teso LLC /Milko/	per day 0,2-0,3	None	-	-
3	Monfresh	per month 200	None		
4	SUU	per day 367.27	None		
5	Vitafit milk	per month 500	per month 8-12	None	-

**Table 15: Waste content**

	Name of the company	What chemicals are in the production line?	Is it a harm to the environment? How?	What kind of waste standarts are followed?	Waste water soluble in water? (yes or no)	What is the composition of waste type? (organic/inorganic, hazardous waste, textile)?
1	APU dairy	Acid and base		ISO: 21000, ISO:14000, MNS		-
2	Teso LLC /Milko/	For cleaning	No	Yes	No	-
3	Monfresh	HNO <sub>3</sub> , NaOH	No	-		-
4	SUU	Микробиологийн лаборатори, хөргөлтийн цех, CIP угаалга, ахуйн угаалга, цэвэрлэгээний зориулалтаар 57 нэр төрлийн химийн бодисыг ашиглаж байна. Химийн лаборатори /HNO <sub>3</sub> , NaOH		Mongolian waste law	Yes	-
5	Vitafit milk	for cleaning NaOH, HNO <sub>3</sub> , CIP ариутгагч	Little	International waste law		-

**Table 16: How waste ends**

	<b>Name of the company</b>	<b>Do you collect your solid/liquid wastes separately? If yes, how?</b>	<b>Any contractor companies for waste/diposal?</b>	<b>How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?</b>	<b>How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?</b>	<b>Cost of disposal?</b>	<b>Any revenue obtained by the produced waste/ recycled or reused?</b>
1	APU dairy	Collect paper waste to Eco orchin	Farmer, pig farm and individuals	Give to farmer, pig farm and individuals and rest of them send to neutrolize the whey liquid then send it to central waste water treatment facility.		None	None
2	Teso LLC /Milko/	only solid wastes like paper	None	None	Landscaping service company	per month 150000	None
3	Monfresh	No	Landscaping service company	None	Landscaping service company	80000	-

	Name of the company	Do you collect your solid/liquid wastes separately? If yes, how?	Any contractor companies for waste/disposal?	How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	Cost of disposal?	Any revenue obtained by the produced waste/ recycled or reused?
4	SUU	1.Reusable solid wastes collected. 2. Liquid whey to sell individuals and small farmers.	Solid wastes are contracted with local municipalities. Wastewater is supplied to the central wastewater treatment facility.	Paper wastes to paper industry	40% орчим хаягддаг. СХД-ийн ТҮК-тай хамтран байгуулсан гэрээгээр зохицуулагддаг.	8,6 million	1 million
5	Vitafit milk		Yes	80% of total solid waste	No		

### 3.4 Introduction of study area

One of the biggest leading mining company is EMC in Erdenet, Mongolia **Error! Reference source not found.**, where exports copper, gold, fluorite and molybdenum ores. EMC is located near to the town of Erdenet in the Bulgan province, approximately 250 kilometers northwest of Ulaanbaatar. Annual production capacity is 26 million tons of ore and producing around 530.0 thousand tons of copper concentrate and around 4,5 thousands tons of molybdenum concentrates (10). When EMC started its operation in 1978, dust of tailing pond was major problem, which has not yet been resolved yet. During the process at most precious metal and base metal mines amount of material mined equal to amount waste, due to low grade of the ore bodies being mined. Waste rock piles and tailing dams can be a source of solid waste and liquid waste pollution. Each year, 10 to 12 million tons of subgrade ore are added to the existing Tailing pond. The wastes from extraction processes are pumped to the Tailing pond, which is located approximately 4 km away from the plant and has a 4 flushing pipes. The Tailing pond contents 700 Mio.m<sup>3</sup> and tailing dam is 100 m high (maximum). Without base sealing and tailing pond has accounted for 18 km<sup>2</sup>.



#### Legend




-  Erdenet city
-  Tailing pond
-  Erdenet Open pit mine

Photo 10: Satellite photo of study area

### 3.5 Field test in EMC

To determine the effectiveness of the reagent as a dust binder in field trial experiment. Passive dust sampler (PDS) overturned plastic cup covered with adhesive carbon pad. So that necessary conditions to floating particles adhere to the carbon pad. The PDS located in

center of selected groups. After one month of experiment carbon pads were necessary to scanning electron microscope. To determine effectiveness of the reagent as a dust binder. Field trial experiment was done by (PDS). Field test divided into four groups of area held in 100 m<sup>2</sup>. Take place in parallel and distance about 100 m far from each other. The first group's experiment done by without any reagents due to serve as a reference. Pure water, wool mixture, milk reagents sprinkled in other groups. Design of field test consists of twelve dust-collecting pads with tape. Four groups of three bars each with the pads arranged. Three wooden rods placed in a line apart from 0.5 m each. Overturned plastic cup positioned on the top of the wooden stick at a height of 1,50 m then carbon pads placed in the tape.

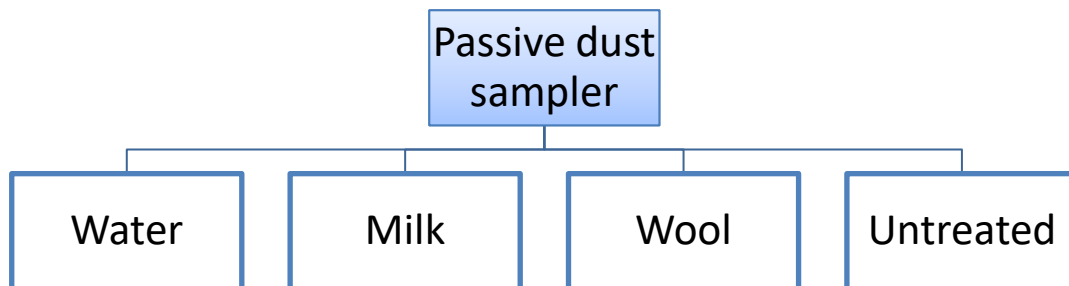


Figure 7 Measuring Building



**Photo 11: Group 1 field test**



**Photo 12 Milk and coarse wool**



**Photo 13: Group 4 milk sprinkled**



**Photo 14: Carbon pads placed under cup**

At the final inspection on 01.11.2018, first groups 2 carbon Pads are found and packed. The two pads were stored in plastic containers secured by tape. So that they are not in contact Raw Materials and Process Engineering student Jargalmaa.O

with the wall of the container. Rest of the 10 carbon pads are gone. It may be attacked by birds and dogs because bird's and dog's track found around the area and bite marks on the plastic caps. Another possible option is pads may blown by wind. The average hourly wind speed in Erdenet is gradually increasing during October, increasing from 7.7 miles per hour to 8.4 miles per hour.



**Photo 15: Removal of tape**



**Photo 16: Dust-collecting pads secured by tape so that they are not in contact with the wall of the container**



Photo 17: Transport container



Photo 18: Empty plastic cup



Photo 19: Missing plastic cup



**Photo 20: Bird marks on surrounding area**



**Photo 21: Bite marks on the plastic caps.**

Dust-collecting pad assumed bitten by birds either destroyed or lost. Two found pads already secured unfortunately it could no longer be available for analysis. To get real experienced data need appropriate protection for sampler from animals, such as cages and scarecrows.

## 4 Results

**In wool industry** Table 11 Bayalag Ulzii LLC's waste is higher than other industry but company sell their waste to small company or individual to produce dees tonoh, nooson tawchik and so on. оүөс can competitive residue as lot as Coarse wool amount. Prices can be negotiable due to where it disposed from for example wool disposal's price at highest 3000 tugrik but coarse Coarse wool can be free to 200 tugrik.

Following Table 12 shows what chemicals are in the production line and more disposal content and characterization questions.

To conclude Table 13 this questionnaires industries have three options: 1. Company's collect and use residues in their company to produce small sized Products. 2. Company's sell their residue to potential small company and/or individuals to make small sized products and 3. Company's throw it to the landfill to burn by Landscaping service company.

**In milk industry** Table 14 shows All factories used to clean equipment, which requires specific amount of water, that waste water is supplied to the central waste water treatment facility. APU dairy and Vitafit milk have a liquid whey residue and three rest factories have mostly paper package.

To sum up Table 15 and Table 16 shows milk companies has solid and liquid wastes. While companies filling the questionnaires specially APU dairy and Vitavit milk companies point out they do research to use it in their company due to its high nutritional quality (25).

## 5 Conclusions

Erdenet Mining Corporation is one of the biggest copper and molybdenum ore mining; and ore processing factory in Erdenet, Mongolia. Main pollution source is white dust from the storage of tailings pond. The tailing pond's waste clay turns into a very fine dust by drying up by sun and wind. Thus, the dust pollution needs to be reduced as soon as possible to acceptable amount, because fine dust's pollution are concerned by negative health hazards such as lung cancer, asthma, bronchitis and pneumoconiosis are endangered to locals and workers.

The objective of this thesis was to reduce the amount of dust emissions on mine surfaces by using regenerative dust-binding reagents based on industrial production residue. The development of dust binders based on waste produced in the Mongolian wool and milk production industry. Quantitative analysis of residues of industrial waste survey generated in according to the list of possible questions. Survey provides necessary disposal informations. Based on survey result dust preventions and dust suppressions made of by waste coarse wool from wool, cashmere and carpet industry. NTG /Erdenet textile/ has dominated in waste of coarse wool. ... Dust preventions and dust suppressions made of by liquid whey from milk industry. Liquid whey has several potential uses such as whey protein, whey powder and so on. Due to essential nutritional use of liquid whey, which is hard to use for dust binders because of lack of source.

Carried out viscous laboratory test to viscosity of different samples. Unfortunately some laboratory experiment did not carried out, due to unavailability of apparatus. One month of field test done in EMC by Passive dust sampler to determine the effectiveness of the reagent as a dust binder. Four reagents /water, milk, wool, untreated/ tested in study area. Unfortunately, at the final inspection of PDS's result assumed by birds either destroyed or lost. Thus, without real data it is impossible to determine the outcome.

## Recommendations

Future students need to pay attention to the laboratory experiment due to the lack of laboratory apparatus some experiment did not covered.

For the field test experiment to get real experienced data need appropriate protection for sampler from animals, such as cages and scarecrows. Or work together with Erdent Mining Company's workers to eye on experimental apparatus. Thus experienced data gets

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## Appendicies

### Introduction

Name of industry/ organisation		"NTG"XXK
Contact person information	Name	D.Kherlentsog
	Position	Consultant
	Phone	99024329
	E-mail	Kherlentsog.D@ntg.erdenet.biz
Address of industry/ organisation	District	Orkhon aimag Bayan-Undur soum
	Bag, Khoroo	Bayantsagaan bag
What kind of production produced?	Wool and cashmere	Primary cashmere wool yarn, carpet, felt, textile, knitwear and clothing
	Milk, bevarage	-
Any residue/waste produced? (Yes, no) If answer "Yes" then contunie on the additional questions		Yes

### Wool, cashmere, carpet waste (year)

How much waste comes and which production process from?	Wool cashmere primary processing, felt and tanning, tanning and sludge	Sludge and clay	2,223.63
		Soil	374.47
		Coarse flock with paint	20
	All production line	Очѐс	143
What chemicals are in the production line?			Technical soda Na <sub>2</sub> CO <sub>3</sub> , soap, Bematin, paint, glaucomer salt, acetic acid, dyestuffs, ammonia, silicate sodium, hydrogen peroxide, Latex
Is it a harm to the environment? How?			No
What kind of waste standarts are followed?			

Waste water soluble in water? (yes or no)	No
What is the composition of waste type? (organic/inorganic, hazardous waste, textile)?	Solid, liquid
Any contractor companies for waste/diposal?	Yes
How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	No
Do you collect your solid/liquid wastes separately? If yes, how?	100% landfill
How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	
Cost of disposal?	
Any revenue obtained by the produced waste/ recycled or reused?	
<b>"NO-DUST" research work by RWTH Aachen University and German-Mongolian Institute for Resources and Technology . In this study, we aim to use animal waste and raw materials and the following information is required.</b>	
How much waste/diposal could they give us?	113.0 ton оrѳс + 20.0 ton coarse wool with paint + soil
How much is it? Is it free?	Prices are based on the commodity price of the year

Introduction

Name of industry/ organisation		Mogolnoos LLC
Contact person information	Name	H.Lkhagvasuren
	Position	Chief Operating Officer
	Phone	96671395
	E-mail	mogolnoos@gmail.com
Address of industry/ organisation	District	Bayantogt soum of Tuv aimag
	Bag, Khoroo	2nd bag of yak wool
What kind of production produced?	Wool and cashmere	wool and cashmere
	Milk, bevarage	milk
Any residue/waste produced? (Yes, no) If answer "Yes" then contunie on the additional questions		Yes

**Wool, cashmere, carpet waste (year)**

How much waste comes and which production process from?	Wash /tonn/	Wastewater	2096м3
		Sludge and clay	7.5тн
		Soil	5%,
	Comb /tonn/	Clean flock	45%=23,3 tonn
		Clean flock Unclean flock	
	Paint /tonn/	Paint water	Nope
	Spinning /tonn/	Очёс	
	Braid /thousand.stuck/	Wastewater	Nope
		Үзүүр утас	Nope

	Knit /thousand.m2/	Wastewater	Nope
		Үзүүр утас	Nope
What chemicals are in the production line?		lismrill ww, Monogen, НУ-1, НУ-2, Остеколь /EW/	
Is it a harm to the environment? How?		No	
What kind of waste standarts are followed?		Mongolian waste management law	
Waste water soluble in water? (yes or no)		No	
What is the compasition of waste type? (organic/inorganic, hazardous waste, textile)?		-	
Any contractor companies for waste/diposal?		Nope	
How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?		No	
Do you collect your solid/liquid wastes separately? If yes, how?		Dump the solid wastes to a special point.	
How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?		at the temporary garbage point indicated by soum governor / fenced /	
Cost of disposal?			
Any revenue obtained by the produced waste/ recycled or reused?		no	
<b>"NO-DUST" research work by RWTH Aachen University and German-Mongolian Institute for Resources and Technology . In this study, we aim to use animal waste and raw materials and the following information is required.</b>			
How much waste/diposal could they give us?		150 ton per year	
How much is it? Is it free?		can be negotiated	

Introduction

Name of industry/ organisation		Eco wool LLC
Contact person information	Name	P.Ganbold
	Position	Deputy Director
	Phone	99040192
	E-mail	ganbold@ecowool.mn
Address of industry/ organisation	District	Darkhan-Uul aimag, Darkhan soum
	Bag, Khoroo	13th bag, South factory area
What kind of production produced?	Wool and cashmere	Manufacture of heat insulation materials for sheep wool construction
	Milk, bevarage	-
Any residue/waste produced? (Yes, no) If answer "Yes" then contunie on the additional questions		Yes

**Wool, cashmere, carpet waste (year)**

How much waste comes and which production process from?	Wash /tonn/	Wastewater	40s a day. (Working at full capacity)
		Sludge and clay	40kg per day (Working at full capacity)
		Soil	Sludge clay and solid waste.
	Comb /tonn/	Clean flock	-
			-
		Clean flock Unclean flock	-
	Paint /tonn/	Paint water	-

			-
	Spinning /tonn/	Очёс	-
	Braid /thousand.stuck/	Wastewater	-
		Үзүүр угас	-
	Knit /thousand.m2/	Wastewater	-
		Үзүүр угас	-
What chemicals are in the production line?			Liquid Soap, Bath Salt, Soda
Is it a harm to the environment? How?			No
What kind of waste standarts are followed?			-
<p><b>"NO-DUST" research work by RWTH Aachen University and German-Mongolian Institute for Resources and Technology . In this study, we aim to use animal waste and raw materials and the following information is required.</b></p>			
How much waste/diposal could they give us?			With full capacity, we can supply 23 tonnes of solid waste per year.
How much is it? Is it free?			100 MNT / kg

Introduction

Name of industry/ organisation		SUU JSC
Contact person information	Name	Ts.Gurgetseg
	Position	Technologist
	Phone	88026986
	E-mail	galtsetseg.ts@mongolmilk.mn
Address of industry/ organisation	District	СХД
	Bag, Khoroo	29 khoroo # 37 of the trade union
What kind of production produced?	Wool and cashmere	Milk dairy products, ice cream,
	Milk, bevarage	protein dairy
Any residue/waste produced? (Yes, no) If answer "Yes" then contunie on the additional questions		Yes

**Wool, cashmere, carpet waste (year)**

How much waste comes and which production process from?	Wash /tonn/	Wastewater
	Liquid waste /tonn/	Worker's household consumption is 56m <sup>3</sup> / day
		Factory technology is 80m <sup>3</sup> / day
		Cleaning equipment of the equipment is 211.2 m <sup>3</sup> / day
		Oil from lubricant used for auto-operation is 12 l / month
	Solid waste /tonn/	Workers' garbage disposal
		Solid waste generated during industrial technology
		Solid wastes from auto-operation
	Chemical /tonn/	Chemical reagents
		Mixed chemicals of sulfuric acid and isozam alcohol 180 l / yr
Packaging of chemicals		

	There are 57 types of chemicals used for microbiological laboratories, refrigerating plants, CIP laundry, household laundry and cleaning. The "Labs Trade", Reactors, "NCS", "Adhimis" LLC, and the microbiological laboratories used in the laboratory and equipment were used as a disinfectant for "Monos farm trade" and "Monmpiofarm" Purchase and Purchase Agreement. / HNO <sub>3</sub> , NaOH r
What chemicals are in the production line?	
Is it a harm to the environment? How?	-
What kind of waste standarts are followed?	Mongolian waste management law
Waste water soluble in water? (yes or no)	-
What is the compasition of waste type? (organic/inorganic, hazardous waste, textile)?	
Any contracter companies for waste/diposal?	1. "Waste water supply and sanitation contraction" with DGUU 2. Waste garbage management is regulated by the agreement with Songinokhairkhan District.
How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	1. Conducting a contract with the suppliers of chemical substances to 100%. 2. 50-60% of the paper waste is sold to private enterprises. / paper boxes, sacks, etc.)
Do you collect your solid/liquid wastes separately? If yes, how?	1. Recyclable solid waste is returned to the financial office. 2. Sets a portion of whey and sells soy milk ice cream and sells to private entrepreneurs.
How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	About 40%. It is governed by a contract concluded with Songinokhairkhan District.
Cost of disposal?	It costs 8.6 million MNT annually for solid wastes.
Any revenue obtained by the produced waste/ recycled or reused?	Packaged recycled packaging boxes are supplied to manufacturers and earn 1 million tugriks.
<b>"NO-DUST" research work by RWTH Aachen University and German-Mongolian Institute for Resources and Technology . In this study, we aim to use animal waste and raw materials and the following information is required.</b>	
How much waste/diposal could they give us?	
How much is it? Is it free?	

**Танилцуулга**

Компани/ Аж үйлдвэрийн нэр	"Машин" ХХК
Холбоо барих хүний мэдээлэл	Нэр: Б.Базармаа Албан тушаал: Уст өмшлөлийн менежер Утас: 89198919 И-мэйл: Баянмаа.1@Togo.mn Дүүрэг: С.Х.Д. Баг, хороо: 18-р хороо
Үйлдвэрлэгчийн хаяг байршил хаана вэ?	1. Ахурааб, сум, 2. Турс. (Хөөн шис)
Ямар бүтээгдэхүүн үйлдвэрлэдэг вэ?	
Хаягдал ялгаруулдаг уу? (Тийм, үгүй) Хариулт Тийм бол судалгааг үргэлжлүүлнэ үү!	Тийм.

**Бүтээгдэхүүний хог хаягдалын мэдээлэл (жилээр)**

Хаягдал аль дамжлагаас, хэдий хэмжээгээр ялгарч байна вэ?	Дамжлтын нэр Жишээ нь: Угаах /тн/	Бохир ус
24 цаг 15 м цус с/уус	- Ахурааб сум	- Ахурааб сум, голдон хийсэн - 4000 хуурааб
	- Цэцгийн цуус	- Морины саван голонд сум, голонд сум
	Цус:	Аво хомоно - 250 м цус (10,750 л)
	Хаягдал аль дамжлагаас, хэдий хэмжээгээр ялгарч байна вэ?	400 голонд сум хомоно 3 м
Тусгай тохиромжтой	Хийсэн	Хуурааб хомоно - хомоно 2.5 м
	Амьсгалын	Хуурааб, сум - хомоно 1.5 м
	Ус хэрэглээ, ариусгал	Урсгал 24-н цагт 200 - 300 м³

4-хөлийн 1-үсэг хойгоор  
Хойгоор сумд  
Энэ хог ахуйн хог багана.

Үйлдвэрлэлийн дамжлагад ямар ямар химийн бодис ашигладаг вэ?	Урсгал, хий, урсгал, урсгал, урсгал
Байгаль орчинд хор хөнөөл учруулдаг уу? Яаж?	Урсгал
Олон улсын ямар хог хаягдлын журам мөрддөг вэ?	Урсгал
Хаягдал усанд уусдаг уу? (тийм эсвэл үгүй)	Урсгал
Хаягдал материалын химийн шинж чанарууд юу вэ? (жинсэ нь: гироскоп)	Урсгал
Хог хаягдлыг устгах гэрээг компаний бий юу? Хэрэв тийм бол аль хаягдал дээр?	Урсгал
Үйлдвэрийн хатуу хог хаягдлын хэдэн хувь нь дахин боловсруулдаг албан байгуулдаг зарж борлуулах эсвэл бусад	Урсгал
Хатуу / шингэн хогийг тусад нь цуглуулдаг уу? Хэрэв тийм бол яаж?	Урсгал
Үйлдвэрт гарсан хатуу хог хаягдлын хэдэн хувь нь хаядаг вэ? Хаана, хэрхэн (булах, хогийн цэгт хаях)?	Урсгал - 177-0 агруул
Хаягдлын хаяхад зарцуулагдах зардал?	Урсгал - 150,000,000 - 0
Үйлдвэрлэсэн хаягдал / дахин боловсруулж ашиглахад ашигласан аливаа орлого нь хэд вэ?	Урсгал

Монгол-Германы хамтарсан ашигт малтмал, технологийн их сургуульд ХБНГУ-ын Аахен хотын технологийн их сургуультай хамтарсан “Уул уурхайн гаралтай тоосжилтыг бууруулах нь” сэдэвт судалгааны ажил хэрэгжиж байна. Энэхүү судалгаанд бил малын гаралтай хаягдал, түүхий элийг ашиглах зорилготой бөгөөд дараах мэдээлэл шаардлагатай байна.

Хэр их хэмжээний хог хаягдал бидэнд өгч чадах вэ?	Урсгал
Хог хаягдал аа хэдэн төгрөгөөр зардаг вэ? Үнэгүй өгөх боломжтой юу?	Урсгал

**Танилцуулга**

Компани/ Аж үйлдвэрийн нэр		Сор Кашвэллор ААК
Холбоо барих хүний мэдээлэл	Нэр	Д. Батцэцэг
	Албан тушаал	Үйлдвэрийн дарга
	Утас	88021636
	И-мэйл	batcengela.sorcashnool.mn
Үйлдвэрлэгчийн хаяг байршил хаана вэ?	Дүүрэг	БНД
	Баг, хороо	20
Ямар бүтээгдэхүүн үйлдвэрлэдэг вэ?	Ноос, ноолууран	✓
	Ус, ундаа, сүү, сүүн	
Хаягдал ялгаруулдаг уу? (Тийм, үгүй) Хариулт Тийм бол судалгааг үргэлжлүүлнэ үү!		нээгддэг.

**Ноос, ноолууран бүтээгдэхүүний хог хаягдалын мэдээлэл (жилээр)**

Хаягдал аль дамжлагаас, хэдий хэмжээгээр ялгарч байна вэ?	Угаах /тн/	Бохир ус		
		Лаг, шавар		
		Шороо		
	Самнах /хялгас ялгах/ /тн/	Цэвэр хялгас	26,0	
		Бохир хялгас		
	Будах /тн/	Будагийн ус		
	Ээрэх /тн/	Очёс	0,7	
	Сүлжих /мян.ш/	Бохир ус	1.340.677 тн	мөч.ш мөч.ш
		Үзүүр утас	300г утас	0,1
	Нэхэх /мян.м2/	Бохир ус		
Үзүүр утас				
Үйлдвэрлэлийн дамжлагад ямар ямар хинмийн бодис ацигладаг вэ?				
Байгаль орчинд хор хөнөөл учруулдаг уу? Яаж?		Dispersant, spinex, саваг, дээгүүр		
Олон улсын ямар хог хаягдлын журамыг мөрддөг вэ?				
Хаягдал усанд уусдаг уу? (тийм эсвэл үгүй)		үгүй		
Хаягдал материалын химийн шинж чанарууд юу вэ? (жишээ нь: гигроскоп)				
Хог хаягдлыг устгах гэрээт компани бий юу? Хэрэв тийм бол аль хаягдал дээр?		TVK		
Үйлдвэрийн хатуу хог хаягдлын хэдэн хувь нь дахин боловсруулдаг албан байгуулагт зарж борлуулах эсвэл бусад үйлдвэрүүдэд хүргэдэг вэ?		97% гарна		
Хатуу / шингэн хогийг тусад нь цуглуулдаг уу? Хэрэв тийм бол яаж?		Бохир ус, хатуу хог - и албан TVK		
Үйлдвэрт гарсан хатуу хог хаягдлын хэдэн хувь нь хаядаг вэ? Хаана, хэрхэн (булах, хогийн цэгт хаях)?		албан үн		
Хаягдлын хаяхад зарцуулагдах зардал?		2.100.000		
Үйлдвэрлэсэн хаягдал / дахин боловсруулж ашиглахад ашигласан аливаа орлого нь хэд вэ?		5.200.000		

Монгол-Германы хамтарсан ашигт малтмал, технологийн их сургуульд ХБНГУ-ын Аахен хотын технологийн их сургуультай хамтарсан “Уул уурхайн гаралтай тоосжилтыг бууруулах нь” сэдэвт судалгааны ажил хэрэгжиж байна. Энэхүү судалгаанд бид малын гаралтай хаягдал, түүхий эдийг ашиглах зорилготой бөгөөд дараах мэдээлэл шаардлагатай байна.

Хэр их хэмжээний хог хаягдал бидэнд өгч чадах вэ?	26.1.
Хог хаягдал аа хэдэн төгрөгөөр зардаг вэ? Үнэгүй өгөх боломжтой юу?	

Коопераци үзвэр хөгжөө  
 Хооёршийн ———  
 Малчид ———  
 Хөгжил ———

} үндэс  
 эргүүлэх

500 — 3000 ₮  
 200 ₮

## Introduction

Name of industry/ organisation		Ulaanbaatar carpet JSC
Contact person information	Name	N.Battsetseg
	Position	Engineer
	Phone	88023515
	E-mail	ubcarpet@gmail.com
Address of industry/ organisation	District	Khan-Uul District
	Bag, Khoroo	2nd khoroo
What kind of production produced?	Wool and cashmere	Manufacture of wool carpets
	Milk, bevarage	-
Any residue/waste produced? (Yes, no) If answer "Yes" then contunie on the additional questions		Yes

## Wool, cashmere, carpet waste (year)

How much waste comes and which production process from?	Wash /tonn/	Wastewater	Wool does not wash.
		Sludge and clay	
		Soil	
	Comb /tonn/	Clean flock	Very low.
		Unclean coarse wool	Washing machine is very dirty and it is discharged directly.
	Paint /tonn/	Paint water	750
			60.0-72.0
	Spinning /tonn/	Очёс	There is no moving thread.
Knit /thousand.m 2/	Wastewater	No water	
	Үзүүр утас	1,5	

What chemicals are in the production line?	Acid paint, sulfuric acid, liquid soap, and tapered glue.
Is it a harm to the environment? How?	Chemicals are injected into the water, sent to the central sewage treatment facility, which is painted and transported by the central waste water treatment plant.
What kind of waste standarts are followed?	It works under the company's "Environmental Management Plan".
Waste water soluble in water? (yes or no)	No.
What is the compasition of waste type? (organic/inorganic, hazardous waste, textile)?	Solid waste
Any contracter companies for waste/diposal?	Waste garbage management is regulated by the agreement with Khan-Uul District.
How much of the solid wastes produced in factory will be sold to recycler individuals or groups or is delivered to other industries?	About 50.0%
Do you collect your solid/liquid wastes separately? If yes, how?	No trash. Solid waste is collected in the factory's yard and collected by the bunker.
How much of the solid waste generated in factory is buried? Where and how (landfill, dumping)?	It is shipped to the contractor and disposed to the landfill. About 50.0% of total solid waste
Cost of disposal?	
Any revenue obtained by the produced waste/ recycled or reused?	Очөс, carpets and cell phones are sold to companies and individuals. An average of MNT 4.5 million per month

<b>"NO-DUST" research work by RWTH Aachen University and German-Mongolian Institute for Resources and Technology . In this study, we aim to use animal waste and raw materials and the following information is required.</b>	
How much waste/diposal could they give us?	Provide a rogues or spinach during the carpet and carpeting process.
How much is it? Is it free?	This offer is 200 MNT per kg. or Free of charge.