ID	33300	**Status**	**Dato**
Risikoområde	Risikovurdering: Helse, miljø og sikkerhet (HMS)	Opprettet	20.03.2019
Opprettet av	Sigvart Eggen	Vurdering startet	20.03.2019
Ansvarlig	Sigvart Eggen	Tiltak besluttet	
		Avsluttet	

Risikovurdering:

Remelting of aluminium packaging

Gyldig i perioden:
3/20/2019 - 3/20/2022

Sted:
Verksted tekniske laboratorier 118

Mål / hensikt
Hensikten med forsøkene er å smelte om aluminiumemballasje for så å måte utbytte / metallkvalitet.
Remelting of aluminium packaging with measurements of yield, thereafter analysis of metal quality.

Bakgrunn
Main series of experiment in masters thesis.

Beskrivelse og avgrensninger
Prior to remelting the packaging will be heat treated, compacted and sorted to assess pre-treatments impact on metal quality and yield. During this pretreatment we make sure that no closed containers are present in the sample material, and we make sure to remove moisture.

Remelting is performed by melting a "heel" of 2.5 kgs of pure aluminium in a crucible, heating to 800 degrees celsius, and then submerging our samples into the liquid aluminium to melt it 500 g at a time, in 4 main chargings each totaling 2.5 kg.

After each charging slag is removed from the crucible with a ladle and weighed, and samples are removed for RPT analysis.

After 4 chargings, the liquid aluminium is decanted into an iron cucile for PoDFA analysis.

Forutsetninger, antakelser og forenklinger
The experiments are performed under close supervision and instruction by SINTEF engineers.

Vedlegg
[Ingen registreringer]

Referanser
[Ingen registreringer]

Oppsummering, resultat og endelig vurdering

I oppsummeringen presenteres en oversikt over farer og uønskede hendelser, samt resultat for det enkelte konsekvensområdet.

Farekilde: **Sample preparation.**

Uønsket hendelse: **Inhalation of ash.**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: **Scratches and cuts due to sharp samples.**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:

Farekilde: **Remelting and crucible handling**

Uønsket hendelse: **Burns during addition of metal, extraction of slags and samples.**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:
Materielle verdier — Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: **Overheated crucible.**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:
Materielle verdier — Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: **Inhalation of crucible fumes**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:
Ytre miljø — Risiko før tiltak: Risiko etter tiltak:

Farekilde: **Decantation of crucible**

Uønsket hendelse: **Spilling of liquid metal on floor**

Konsekvensområde: Materielle verdier — Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: **Burns due to hot crucible**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:

Farekilde: **Decantation of crucible**

Uønsket hendelse: **Significant spill during decantation.**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:
Materielle verdier — Risiko før tiltak: Risiko etter tiltak:

Farekilde: **Ash removal from samples**

Uønsket hendelse: **Cutting hands on sharp material edges**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: **Production of flyash**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: **Cement mixer falling over**

Konsekvensområde: Helse — Risiko før tiltak: Risiko etter tiltak:
Materielle verdier — Risiko før tiltak: Risiko etter tiltak:

Endelig vurdering

Involverte enheter og personer

En risikovurdering kan gjelde for en, eller flere enheter i organisasjonen. Denne oversikten presenterer involverte enheter og personell for gjeldende risikovurdering.

Enhet /-er risikovurderingen omfatter

- Institutt for materialteknologi

Deltakere

Leiv Kolbeinsen

Lesere

Dmitry Slizovskiy

Andre involverte/interessenter

Anne Kvithyld (Seniorforsker SINTEF og veileder)
Kurt Sandaunet (Ingeniør SINTEF)
Arne Nordmark (Ingeniør SINTEF)

Følgende akseptkriterier er besluttet for risikoområdet Risikovurdering: Helse, miljø og sikkerhet (HMS):

Helse	Materielle verdier	Omdømme	Ytre miljø
			

Oversikt over eksisterende, relevante tiltak som er hensyntatt i risikovurderingen

I tabellen under presenteres eksisterende tiltak som er hensyntatt ved vurdering av sannsynlighet og konsekvens for aktuelle uønskede hendelser.

Farekilde	Uønsket hendelse	Tiltak hensyntatt ved vurdering
Sample preparation.	Inhalation of ash.	Dust mask
	Scratches and cuts due to sharp samples.	Dust mask
	Scratches and cuts due to sharp samples.	Working gloves
Remelting and crucible handling	Burns during addition of metal, extraction of slags and samples.	Heat resistant trousers, jacket, helmet and shoes
	Burns during addition of metal, extraction of slags and samples.	Overcoat, oveerpants, shoecovers, gloves and visor designed to withstand liquid metal
	Burns during addition of metal, extraction of slags and samples.	Restricting access to parts of the laboratory during procedure
	Burns during addition of metal, extraction of slags and samples.	Supervision by seasoned metallurgy engineers
	Overheated crucible.	Heat resistant trousers, jacket, helmet and shoes
	Overheated crucible.	Overcoat, oveerpants, shoecovers, gloves and visor designed to withstand liquid metal
	Overheated crucible.	Restricting access to parts of the laboratory during procedure
	Overheated crucible.	Supervision by seasoned metallurgy engineers
	Inhalation of crucible fumes	Ventilation system
	Inhalation of crucible fumes	Restricting access to parts of the laboratory during procedure
	Inhalation of crucible fumes	Supervision by seasoned metallurgy engineers
Decantation of crucible	Spilling of liquid metal on floor	Heat resistant trousers, jacket, helmet and shoes
	Spilling of liquid metal on floor	Overcoat, oveerpants, shoecovers, gloves and visor designed to withstand liquid metal
	Spilling of liquid metal on floor	Restricting access to parts of the laboratory during procedure
	Spilling of liquid metal on floor	Supervision by seasoned metallurgy engineers
	Burns due to hot crucible	Heat resistant trousers, jacket, helmet and shoes
	Burns due to hot crucible	Overcoat, oveerpants, shoecovers, gloves and visor designed to withstand liquid metal
	Burns due to hot crucible	Restricting access to parts of the laboratory during procedure
	Burns due to hot crucible	Supervision by seasoned metallurgy engineers
	Significant spill during decantation.	Heat resistant trousers, jacket, helmet and shoes

Decantation of crucible	Significant spill during decantation.	Overcoat, oveerpants, shoecovers, gloves and visor designed to withstand liquid metal
	Significant spill during decantation.	Restricting access to parts of the laboratory during procedure
	Significant spill during decantation.	Supervision by seasoned metallurgy engineers
Ash removal from samples	Cutting hands on sharp material edges	Working gloves
	Production of flyash	Ventilation system
	Production of flyash	Dust mask
	Cement mixer falling over	Restricting access to parts of the laboratory during procedure
	Cement mixer falling over	Supervision by seasoned metallurgy engineers

Eksisterende og relevante tiltak med beskrivelse:

Heat resistant trousers, jacket, helmet and shoes
[Ingen registreringer]

Overcoat, oveerpants, shoecovers, gloves and visor designed to withstand liquid metal
[Ingen registreringer]

Ventilation system
[Ingen registreringer]

Restricting access to parts of the laboratory during procedure
[Ingen registreringer]

Supervision by seasoned metallurgy engineers
[Ingen registreringer]

Dust mask
[Ingen registreringer]

Working gloves
[Ingen registreringer]

Risikoanalyse med vurdering av sannsynlighet og konsekvens

I denne delen av rapporten presenteres detaljer dokumentasjon av de farer, uønskede hendelser og årsaker som er vurdert. Innledningsvis oppsummeres farer med tilhørende uønskede hendelser som er tatt med i vurderingen.

Følgende farer og uønskede hendelser er vurdert i denne risikovurderingen:

- **Sample preparation.**
  - Inhalation of ash.
  - Scratches and cuts due to sharp samples.
- **Remelting and crucible handling**
  - Burns during addition of metal, extraction of slags and samples.
  - Overheated crucible.
  - Inhalation of crucible fumes
- **Decantation of crucible**
  - Spilling of liquid metal on floor
  - Burns due to hot crucible
  - Significant spill during decantation.
- **Ash removal from samples**
  - Cutting hands on sharp material edges
  - Production of flyash
  - Cement mixer falling over

Detaljert oversikt over farekilder og uønskede hendelser:

Farekilde: Sample preparation.

Prior to remelting, sample must be prepared into proper batches. The samples may be covered in ash, organic residue, and will require cutting with metallurgy scissors.

Uønsket hendelse: Inhalation of ash.

Inhalation of ash from the samples may cause discomfort and induce mild allergic reactions

Årsak: (uten tittel)

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

There is often ash on the sample, and the ash is very fine in nature.

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: Ash, like wood ash, is very unreactive in nature and may only induce discomfort and slight allergic reactions.

Uønsket hendelse: Scratches and cuts due to sharp samples.

Scratches and cuts due to handling of sharp samples might occur. To reduce this risk working gloves are worn during sample preparation.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

Unlikely due to propre usage of gloves.

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Middels (2)**

Kommentar: The scratches and cuts sustained would most likely be tiny and inconsequential

Farekilde: Remelting and crucible handling

Uønsket hendelse: Burns during addition of metal, extraction of slags and samples.

Burns might occur during extraction of samples and slag or during addition of metal to the 800 degrees celsius crucible. The biggest danger would be splashing of metal due to dropping heavy samples into the melt, or by the release of moisture from the samples.

Moisture is avoided by heat treating all samples, and keeping them hot prior to melting.

Samples are carefully lowered into the crucible with a tong to avoid splashing.

During the entire experiments, heat resistant boots, trousers, jacket and helmet w visor designed to withstand liquid metal is worn.

During addition and extraction, overcoat, pants, shoe-covers and gloves designed to withstand liquid metal is worn.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Konsekvensområde: Materielle verdier

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Uønsket hendelse: Overheated crucible.

Due to addition of reactive materials, or keeping the furnace at too high effect, the crucible could reach too high temperature, which could lead to unforseen burns and equipment catching on fire/melting.

The temperature of the crucible is therefore monitored with a thermocouple throughout the experiment, and if such an incident occurs, we simply reduce furnace power and wait for the crucible to cool down.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Konsekvensområde: Materielle verdier

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Uønsket hendelse: Inhalation of crucible fumes

During remelting, the crucible might emit unknown fumes.

Ventilation in place minimalizes exposure to such fumes.

Note that there is nothing in our experiment (aluminium and ash) that could produce dangerous gases.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Risiko:

Farekilde: Decantation of crucible

The decanting of the crucible post experiment is an important procedure. Approximately 10 kg of liquid aluminium will be decantented, it will hold a temperature of approximately 800 degrees celsius.

Uønsket hendelse: Spilling of liquid metal on floor

During decantation we could spill liquid metal on the floor.

The floor is designed to withstand liquid metal with no issue, and this would only be a minor inconvenience.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Materielle verdier

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Uønsket hendelse: Burns due to hot crucible

The now exposed crucible with emit significant heat in the form of radiation.

This is neutralized by wearing clothing designed to withstand liquid metal during decantation.

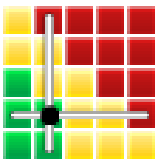
Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:



Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Uønsket hendelse: Significant spill during decantation.

A significant spill due to stumbling, tripping, falls etc during decantation would pose a serious hazard to surrounding materials and people that come into contact with the spilled material.

The risk is reduced by practice prior to decantation, keeping a clean work, tidy work environment, closing down parts of the laboratory to people not in protective garbment, and of course by wearing clothing designed to withstand liquid metal during the experiment itself.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Stor (3)**

Kommentar: [Ingen registreringer]

Konsekvensområde: Materielle verdier

Risiko:

Vurdert konsekvens: **Stor (3)**

Kommentar: [Ingen registreringer]

Farekilde: Ash removal from samples

In order to improve remelting metal yield and quality, the heat treated material is stirred in a cement mixer so that ash falls off.

Uønsket hendelse: Cutting hands on sharp material edges

The metallic sample material could have or develop sharp edges during operation which could leave to cutting of hands during material handling.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Lite sannsynlig (2)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Uønsket hendelse: Production of flyash

Fine ash could turn air born due to small grain size. Air born ash is an irritant to eyes, skin and airways, and could cause allergic reactions.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Sannsynlig (3)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Uønsket hendelse: Cement mixer falling over

The cement mixer is heavy, with a very high center of mass, and very thin legs. If the cement mixer charged with materials fell over this could break equipment or legs.

Consider attaching the cement mixer with screws to a pallet to reduce tipping probability.

On inspection the cement mixer seems not not tip easily, indeed it is designed not to tipp.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Risiko:

Vurdert konsekvens: **Stor (3)**

Kommentar: [Ingen registreringer]

Konsekvensområde: Materielle verdier

Risiko:

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Oversikt over besluttede risikoreduserende tiltak:

Under presenteres en oversikt over risikoreduserende tiltak som skal bidra til å reduseres sannsynlighet og/eller konsekvens for uønskede hendelser.

Detaljert oversikt over besluttede risikoreduserende tiltak med beskrivelse:

Detaljert oversikt over vurdert risiko for hver farekilde/uønsket hendelse før og etter besluttede tiltak