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DECEMBER 2020

FEATURE ARTICLE
Molten Aluminium

PHOTO(S) OF THE MONTH
Molten Aluminium Incidents

BONUS ARTICLE
Molten Metal Incidents Report 2020

BACK TO BASICS
Question Of The Month


WISHING
YOU & YOUR
FAMILY A
HAPPY
NEW YEAR
2021

ALUMINIUM

Aluminium is the most abundant metallic element in the Earths crust, about 8%, and is the third most common element after Oxygen and Silicon. Unlike Copper or Gold, Aluminium cannot be found in nature in the pure state because of its high affinity with Oxygen, being so, always combined with another element like in Alum ($KAl(SO_4)_2 \cdot 12H_2O$) and in Aluminium Oxide (Al_2O_3). So, up to 1820, Aluminium was unknown as a metal.

In the 19th century, Aluminium was considered a precious metal ($1200/kg in 1852). Indeed, a story tells that during banquets, the most honoured guests of Napoleon III, Emperor of France, were served in Aluminium utensils, while the other guests were served in Gold utensils.

Presently, Aluminium is the second largest used metal in the world, mainly due to its light weight, high strength and recyclability. Because of its durability, strength and light weight, it has found ample use in the Automobile & Aviation industry. Aluminium's weight is one third of Steel or Cast Iron. Considering increased thickness of the Aluminium parts compared to Steel, 1 kg. of Aluminium replaces 2 kg. of Steel, leading to lighter cars, trucks, etc. which in turn, reduces fuel consumption and CO_2 generation.

Without Aluminium, the commercial aircraft industry would not have existed. The new A380 employs 66% of Aluminium in the airframe, while a Boeing 747 contains 75 tons of Aluminium.

The use of Aluminium, for the building of ships, is increasing, year by year. Today, single and multiple hull boats are made entirely of Aluminium alloy. This kind of marine applications involve the largest usage of Aluminium per produced object (400 ton) compared to a large, all Aluminium car (1 ton).

In building and construction, Aluminium finds a wide variety of applications, and its use is steadily increasing. Curtainwall made of extruded Aluminium and glass are very attractive for the design of new buildings or retrofit on old ones. Windows made of extruded Aluminium are attractive, energy-efficient (with thermal broken technology) and reliable. Domes for gymnasiums, schools, theme parks, storage facilities, multi-purpose arenas, industrial roof systems, and churches are made with Aluminium because of its strength and low weight.

Aluminium also finds a wide use in the packaging industry, being produced in both, rigid and foil forms. Rigid Aluminium containers are used for beverage and food packaging. Aluminium cans account for all of the beverage can market, but only a small percentage of the food can market. Cans are 79 percent of Aluminium packaging by weight. Foil packaging is used as a wrapping foil, as semi-rigid packages such as pie plates and frozen food trays, and as flexible packaging such as cigarette foil and candy wrappers.

The usage of Aluminium is increasing in the military field too, where it is used as a substitute for Steel.

WHY TRANSPORT MOLTEN ALUMINIUM?

Aluminium's heat of fusion (the energy input required to make some of it melt, or the energy released when it freezes back into a solid) is 321 kJ/kg. For comparison, Gold is 67 kJ/kg, Iron is 126. Since melting Aluminium is such an energy-intensive process, transporting it in a liquid state can be cheaper than moving a solid brick and re-melting it.

Molten Aluminium purchasing can result in various advantages. Molten metal transportation means energy delivery as two expensive steps are avoided: the production of Aluminium ingots by the supplier and their re-melting at the customer. On the other hand, safety and technical issues must be addressed to handle molten metals and set suitable logistics, aiming to inhibit metal freezing in the crucible.

In order to attain a successful process,

the refractory selection and design of the molten Aluminium transportation ladles are key issues. A molten Aluminium transportation crucible comprises of a dense refractory for Aluminium contact, an insulating layer to inhibit heat loss and metal freezing, a removable lid (where the metal is loaded) and a slide gate valve (where the metal is tapped at the customer furnaces trough). Thermal insulation of ladle is essential to save energy and provide high temperature, molten Aluminium to the customer.

Regarding the thermal properties, there are three different steps that must be considered:

1) Crucible pre-heating
2) Loading and transportation to the customer and
3) Unloading and transportation of the empty crucible back to the Aluminium manufacturer

Among them, the first one is of utmost importance to ensure a suitable delivering temperature (reduce heat exchange between the refractory and the metal) and also to minimize the refractory damage by thermal shock. The pre-heating schedule is designed to provide time for gradual heating of the

refractory's internal lining surface, up to a temperature close to the molten metal. Afterwards, a soaking time is required in order to make sure that the crucible is close to the equilibrium condition and ready for Aluminium tapping. When this step is over, the molten metal is then loaded, and the crucible is placed on a truck. On the road, the temperature of the molten metal starts to decrease as heat is transferred from the metal to the refractory and to the environment.

TRANSPORTATION

Transport of up to 800°C liquid Aluminium in special crucibles, from the production sites of high-profile Aluminium producers and smelting plants. Liquid Aluminium customers are predominantly manufacturers of car and aircraft components.

Custom-built refractory crucibles carrying molten Aluminium are loaded on flat-bed trailers but can be loaded on any adequate carrying capacity truck. The crucibles must be duly lashed, using strong metal chains & such lashing also accounted for exigencies of speed and braking of carrying vehicle. Select transport companies that specialise in carrying such cargoes, have requisite experience over different geographies, in the intended routes and have exposure to carrying such cargoes in all-weather conditions.

- The driver & support staff should be duly educated about dangers of carrying molten Aluminium and what are the reactive agents that can cause spill or accidents
- The driving staff should be fully made aware of the consequences of

over-speeding, running over a speed breaker or through potholes

• Precautions should be taken when driven over a stretch of tilted or angular roads, sharp turns, going over bridges or entering or exiting roads, road crossings or even when approaching to brake on wet roads

• The staff should be trained, not only to check lashings of ladles but also to ensure that they take due precautions while doing that and also ensure that they do not tamper with any other section of the ladle as well as others are prevented to do that.

For even higher quantities, Rail-mounted ladles with complete mechanism to empty them at destination, are better options and should be the preferred mode, wherever possible. The rail transportation of such cargo is considered much safer than road transportation.

MOLTEN ALUMINIUM ACCIDENTS

Failure to use proper procedures in melting and casting Aluminium can be dangerous. Molten Aluminium is typically handled at 1300-1450 degrees Fahrenheit, to avoid premature solidification. Contact with molten Aluminium can cause severe burns and create a serious fire hazard. Mixing water or other contaminants with molten Aluminium can cause

explosions. Explosions can also occur in the Aluminium scrap re-melting process due to moisture and contamination in scrap.

These explosions range widely in violence and can result in injury or death as well as destruction of equipment and plant facilities. Where there is possibility of splash or other direct exposure, personnel working with molten Aluminium must wear eye and face protection as well as protective clothing.

PHOTOS OF THE MONTH

MOLTEN ALUMINIUM SPILL

MOLTEN TRUCK ACCIDENT

ANNUAL SUMMARY REPORT ON MOLTEN METAL INCIDENTS IN US FOR 2019

(Edited to specifically include transfer/transportation incidents) September 2020

Credit: The Aluminum Association

For the year 2019, 163 reports were received on incidents occurring world-wide as compared to 170 reports received for 2018 and 181 reports for 2017. The attached figures summarize the reports for 2019 as well as the data for the years 1980 thru 2019.

SUMMARY POINTS:

- For 2019, there were 163 explosion incidents reported, which is slightly lower than the historically high incidents reported over the previous four years (170 – 195).
- There were 135 Force 1 explosions, 27 Force 2 explosions and one Force 3 explosion reported in 2019.
- The one Force 3 incident occurred during a metal Transfer operation, which, although it is not unique, is rare in that there had only been 9 previous Force 3 Transfer explosions reported from a total of 118 Force 3 incidents for the entire reporting period from 1980 through 2018.
- The single Force 3 incident was the result of a spill from an overfilled crucible at a Recycling location, along with a wet and uneven floor. There was one Serious injury, along with heavy equipment and building damage.
- There were 27 Force 2 incidents reported which is the highest number of Force 2 incidents since 28 were reported in 2007. There has been a rising number of Force 2 incidents over the past 4 years, averaging 22/year. Most of the Force 2 explosions in these last 4 years occurred in Casting (41), vs. Melting (37), **Transfer (6)** and Other (5). This is atypical of historic data where Force 2 explosions predominately occurred in Melting by a wide margin.
- There was a total of 15 reported injuries, which included 12 minor injuries, three serious injuries and zero fatalities.

- The 15 injuries in 2019 is the 2nd lowest total number of annual injuries for the entire length of the incident reporting program from 1980 through 2019 with 2017 being the lowest with 8 Minor injuries, 0 Serious and 0 Fatal.
- **There were 4 injuries in Transfer operations, three being classified as serious, with one serious injury occurring from the Force 3 incident.**
- Only one minor injury occurred in Melting operations.
- Over the past 7-10 years the injury rate (injuries/incident) for Melting, Casting and Transfer operations continued to be low or demonstrate a downward trend, as was initially presented in the 2019 report. The exceptions were in 2015 and 2018 as noted above.
- This lower injury frequency can be attributed at least partially to: 1) the increased use of primary and secondary PPE; 2) improvements in PPE materials and design; 3) an increased focus on hands-free casting operations that remove personnel from high risk casting operations; and 4) possibly increased training and hazard awareness.
- New analysis and charts were added to the 2020 Report reviewing major causes of Casting and Transfer explosions over recent years. These charts highlight that most Force 2 & 3 Casting explosions are caused during DC cast starts due to excessive curl / hang-up / bleed-out, while most Transfer Force 2 & 3 explosions are due to wet / rusty drain pans. For these large Force Transfer explosions, wet / rusty drain pans cause almost 3 times the number of incidents as the next leading cause.
- There were no Extrusion plant injuries in 2019. There were 9 Force 1 and one Force 2 incidents reported from Extrusion plants.

BACK-TO-BASICS

QUESTION OF THE MONTH

Why is molten aluminium preferred over solid ingots?

LAST MONTH'S QUESTION

Client ABC had imported some Project Cargoes on CIP Incoterms 2020 from Germany. ABC had also insured the shipment under a separate Cargo Policy in India since the Imports of Project Cargoes included Imports on FOB/CFR/EX-Works terms. Under the Policy issued by the Indian Underwriters, cover on such CIF shipments were covered from FOB point.

On a CIF shipment which was imported in FCL Container, cargo was cleared and taken to the Importers' premises. At the time of de-stuffing, some equipment's were found rusted. Salinity test proved that rusting was on account of sea water ingress. The loss amount was INR 50 lakhs plus Customs Duty of INR 10 Lakhs.
Is the claim payable admissible, by the Indian Underwriters?

LAST MONTH'S ANSWER

NOTE: There was an error in our QOTM, while we have mentioned in paragraph one that Cargo was imported on CIP basis, in the second paragraph, we have stated that Cargo was imported on CIF basis. We regret the inconvenience caused to our readers. We also thank our readers who still attempted to answer to question.

ANSWER: Claims is admissible since cover for CIF Imports did not exclude ICC-B Perils.

CORRECT ANSWERS SENT BY: (In order of replies received)

- SOHAG PARIKH – Cadila Healthcare Ltd., Ahmedabad
- AZAD KUMAR - UIB Insurance Brokers (India) PVT. Ltd., Mumbai
- BHARAT BHUSHAN - Optima Insurance Brokers Pvt Ltd., New Delhi

Please send your replies/answers ONLY to: marine.newslink@tataaig.com

IF YOU HAVE ANY COMMENTS / FEEDBACK PLEASE SEND IT TO

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