

Investigation on Suspected Corona Virus and Harmful Bacteria in Sand Moulding Foundries - Preliminary Study

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Abstract

Vast research has been carried out on the atmospheric pollution created by mould gas and dust in foundries. In early 2020, outbreak of Corona virus in almost all countries of the world has urged the material scientists to search further presence of Corona virus and other bacteria on the surface of different materials. Surfaces of some of the materials on which COVID 19 can live are plastic, stainless steel, cardboard, Glass, Ceramics, Cu, Al and fixtures made of them. This paper presents a study about this viral and bacterial pollution in foundries. Samples from sand moulding foundries were taken, observed in the high magnifying microscope and suggestions are put forth for their control in foundry atmosphere.

Keywords: Coronavirus (COVID-19), artificial intelligence, lockouts, social impact

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1. INTRODUCTION

Like any other industry, the atmosphere of foundry is not free from pollution. Principal forms of industrial pollutions existing in atmosphere of foundry are classified as gaseous, thermal, radioactive and sonic pollutions, which are created by gases from furnaces, moulds cores and those evolved during metallurgical treatments e.g. flux addition, inoculation, refining, degassing etc. thermal radiations omitted by hot bath of furnace, X-ray and radioactive elements used in N.D.T. and high level noise given by electric furnace during manufacturing of steel [1].

In some old small foundries which are not equipped with modern facilities of moulding & mixing, core making, the workers mix the sand ingredients such as SiO₂ sand, clay, bentonite, water and number of other special additives with hands and prepare the

mould with old foundry tools. The raw materials such as natural bonding sands generally come from the river and lake beds. The mould sand once used for moulding and casting is heaped outside the foundries and instead of reclaiming, it is reused. All these factors increase the risk to the safety of the personnel working in a foundry.

According to the Punjab Occupational Safety and Health Act, 2019 (IV of 2019) it is the prime duty of the employer to take all possible and reasonably practical measures to ensure safety and health of the employees at work place and make arrangements to control and prevent physical, chemical, biological, radiological, ergonomics and psycho-social or any other hazards to the employees and other persons at the workplace [16].

Vast research has been carried out on the atmospheric pollution created by mould gas

and dust, but very few papers have been produced on some bacterial infection which may exist in the atmosphere of foundries. In early 2020, outbreak of Corona virus in almost all countries of the world has urged the foundrymen to research further on the atmosphere of foundry and all the materials used for moulding and casting to investigate the presence of Corona virus and other bacteria. This paper presents a study about viral pollution which may exist in the atmosphere of foundries.

2. CORONA VIRUS PANDEMIC

While our society is on the cusp of harnessing recent advances the mankind is at the severe threat from unknown bacteria and viruses. COVID-19 (Novel Corona Virus-19) is a new strain of corona virus (a large family of viruses) that had previously not been identified in humans. In Dec. 2019, scientists detected Corona virus (COVID-19) (see fig.1 & 2). This virus camouflage itself in a thin film of fat. It was first detected in some citizens of Wuhan province of China. They were reported to be caught by cold and severe 'flue'. The investigation revealed that it was due to a very dangerous virus named as 'Corona virus'. In this deadly disease, the patient feels unrest, continuous flue, inflammation in nostrils and throat, upset of respiratory system, pain in shins and swelling of eyes. After some days of illness the flue may change into 'pneumonia' which ultimately causes death of the patient. The main cause of spread of this disease as indicated by the specialists is shaking hands, embracing and participating in the gatherings. On shaking hands the virus is transferred from the affected person to healthy person and when he touches his mouth and eyes, the virus travels in the throat and lungs.

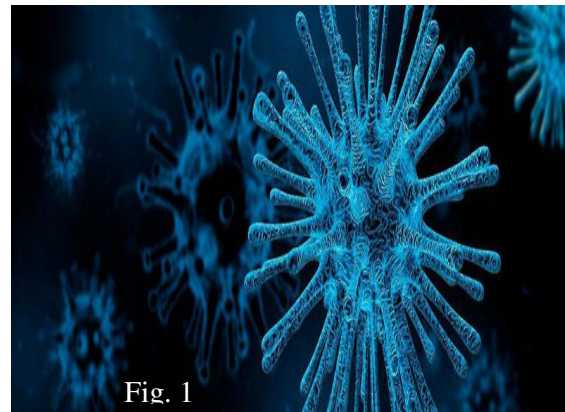


Fig. 1

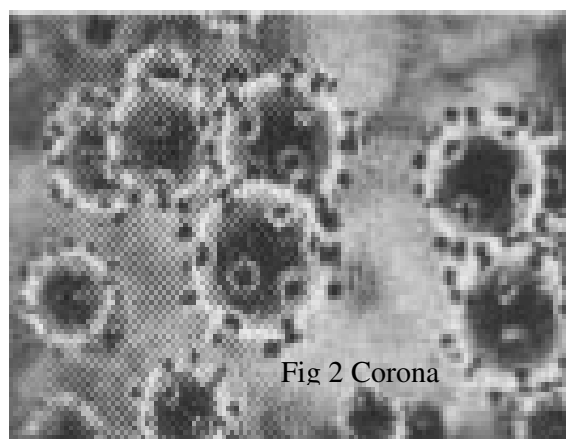


Fig 2 Corona

Fig. 2 (a-d) scanning of corona virus by artificial intelligence

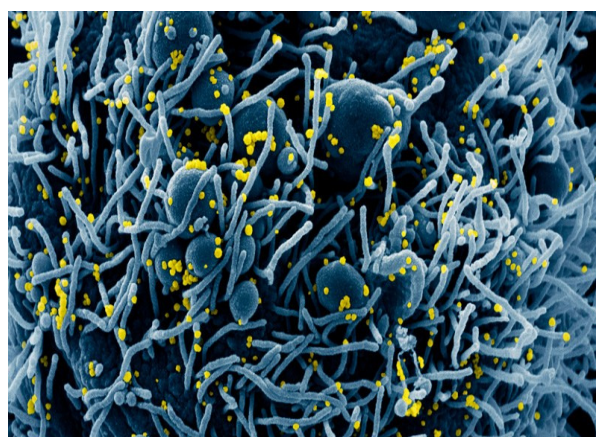


Fig. 2 (a) A human cell (blue; artificially coloured) infected with SARS-CoV-2 (yellow).Credit: NIAID/National Institutes of Health/SPL

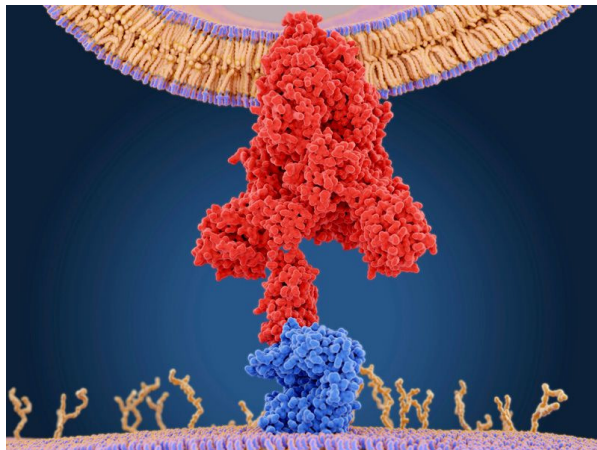


Fig. 2 (b) One of the spike proteins (red) on a SARS-CoV-2 particle grabs a receptor on a cell. Credit: SPL

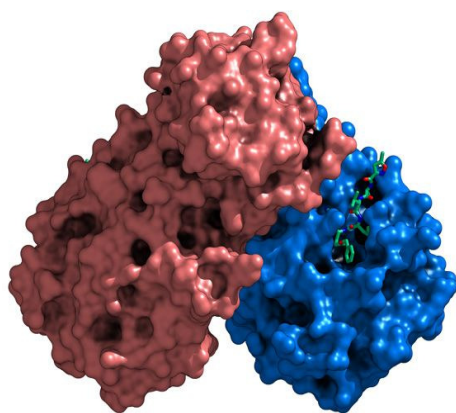


Fig. 2 (c) One of SARS-CoV-2's key enzymes consists of two units (blue and red; artist's impression) and includes a hollow where candidate drugs (green) can bind the enzyme. Credit: Z. Jin *et al./Nature*

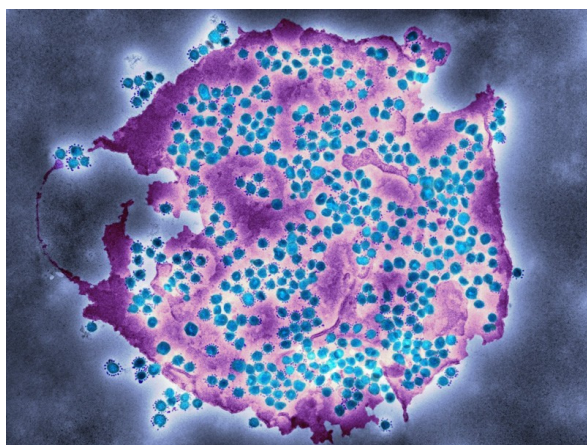


Fig. 2 (d) Particles (blue) of the virus that causes COVID-19. Credit: National Infection Service/SPL

In early 2020, this virus took the shape of pandemic disease and spread almost all the countries of world. The most affected countries were, China, Italy, United States of America, Iran, Spain, France, UK (see fig.3 & 4). The media all over the world reported continuously the latest situation of the death toll and affected personnel. The death toll rose to the thousands and affected peoples were counted in million.

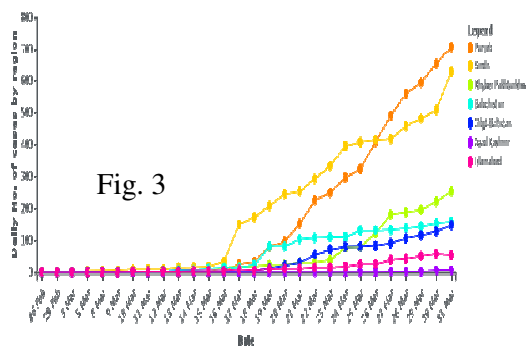
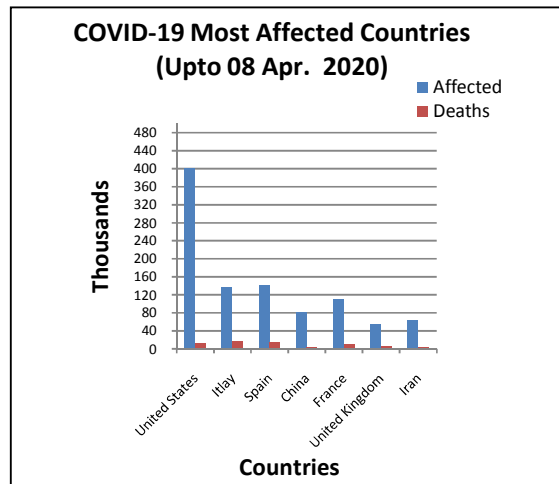


Fig.4 Daily number of Corona virus cases confirmed in different regions of Pakistan (March 2020)

Respiratory viruses are responsible for more deaths globally than any other infectious agent. Animal corona viruses that “host jump” to humans result in severe infections with high mortality, such as severe acute respiratory syndrome (SARS) and, more recently, Middle East respiratory syndrome (MERS). We show here that a closely related human corona virus,

229E, which causes upper respiratory tract infection in healthy individuals and serious disease in patients with comorbidities, remained infectious on surface materials common to public and domestic areas for several days. The low infectious dose means that this is a significant infection risk to anyone touching a contaminated surface. However, rapid inactivation, irreversible destruction of viral RNA, and massive structural damage were observed in coronaviruses exposed to copper and copper alloy surfaces. Incorporation of copper alloy surfaces in conjunction with effective cleaning regimens and good clinical practices could help to control transmission of respiratory corona viruses, including MERS and SARS [27].

Ergonomic and Safety: Further, the analyzed ergonomic factors is not only air temperature, but the total impact of such factors as: thermal radiation and its properties, temperature differences for particular segments of the body, the speed of air flow, pressure differences, relative humidity, etc.

As an industry, foundries consistently experience high injury incidence rates ranking in the top 25 of all industries for at least the past 10 years (Bureau of Labor Statistics (BLS) 1997-2007). Of all the types of industries sustained in primary metal manufacturing, NAICS code 331, which includes foundries, the highest frequency of injuries from OSHA recordable industries in 2007 were sprains, stains and tears, 34.6% (BLS, 2007). Therefore, foundries aim to reduce injuries, and the costs associated with these injuries, not only to remain competitive but also to maintain their skilled workforce.

3. CORONA VIRUS AND BACTERIA ON METAL SURFACE

The corona virus may stay healthy at the living beings as well as at the paraphernalia such as belongings, cloths, tables, sheets, file covers, reel of stairs etc. The researchers, in new study, tested the virus life span at different materials, at 71-degree Fahrenheit room and 65% relative humidity. After three hours, the

virus had disappeared from printing and tissue paper. It took two days, to leave wood and cloth fabric (fig. 5). After four days, it was no longer detectable on glass or paper money. Virus can live upto 4 hours on copper and upto a day on cardboard. It lasted the longest, seven days, on stainless steel and plastic. It shows that temperature and humidity play a role in 'how long the virus survives'. Corona viruses have a viral envelope: a protein layer that protects viral particles when they travel from person to person in the air. This sheath can dry out, killing the virus. Temperature and humidity affect that process.



Fig. 5 Corona virus on Fabric

Bacteria on Iron Objects

Considerable attention has also been given to the influence of bacteria upon iron. The growth of *Crenothrix* may cause much trouble in waterworks. A variety, *Chlamydothrix* (*Gallionella*) *ferruginea* (Mig.) appears to play an important part in the formation of rust.

Jackson gives micro-photographs of these varieties. Microscopically the masses of *Crenothrix* are seen enclosed in a gelatinous sheath, in which is imbedded the precipitated metallic hydrate. It is anaerobic and its action is favoured by absence of light. In the absence of dissolved oxygen, the bacillus appears to take its iron from the pipes. *Cr. Polyspora* is found however to separate the iron not from the ferrous carbonate (FeCO_3) but from iron organically combined.

Recently scientific investigations carried out to study microstructure and surface morphology of evolution of thin films on the

metallic surfaces has clarified the different stages in formation of oxide films on the iron objects [6]. These compose: nucleation, crystal growth, coalescence, filling the channels, growth if continuous film, thickening of film by deposition of layers, and finally powdering due to loosely adhering layers. Condensation starts by nucleation and sites of nuclei are connected in many cases to active centers (such as defects, impurities etc) in substrate surface. Primary crystals grow independently of each other. Then coalescence takes place when growing adjacent grains approach and touch each other. Channels formed in primary coalescence (or incomplete coalescence) are filled by secondary coalescence (or complete coalescence). This ultimately forms the continuous film. As the film thickens due to the deposition of more material, different layers in the thick film could not adhere properly and are powdered.

4. GLOBAL IMPACTS

Corona virus has affected the overall economy of the world. The metal industry is also not spared. Although the consequence of corona virus on light metal industry are not yet fully foreseeable but the estimates of upto this time, show that spread of corona virus will continue to affect the light metal-casting industry. As the precautionary measures, numerous trade fairs and large number of the events organized by metal industry all over the world, have been cancelled or postponed. The international trade fair for tool and mould making originally planned on Feb. 26-28, 2020 in Guangzhou, has been postponed. CastForge 2020, trade fair for cast and forged parts has been postponed to June 8-10, 2021. A very interesting event for die casters, Zinc Die Casting Conference has also been postponed from June 2020 to year 2021.

Corona crisis has also affected Aluminum industry and it has shown a significant decline in production. German aluminum industry Gesamtverband der Aluminiumindustrie e. V (GAD), Dusseldorf has significantly reduced its production. Another problem affecting foundries is that the

far-reaching production stop in the automotive industry is reducing the demand for cast components. This has hit particularly hard medium-sized and small foundries, which mainly produce components for the aforementioned industry. Due to the loss of orders, foundries must now think and find creative alternatives.

Automakers including Honda, Toyota and Hyundai have announced plant shutdowns in response to supply chain issues with the corona virus, but one thing's for sure: the auto industry has not seen the worst yet. One factor is the unknown – how far and fast the virus will spread, and who will be quarantined. Another factor is the lag time between when parts are produced and when the plants actually receive them (fig. 6 & 7).



Fig. 6 Auto Industry



Fig. 7 Safety in Casting

5. PREVENTION

5.1 Precautionary Measures

The specialist doctors took the precautionary measures and suggested tips to avoid the spread of the disease. The general public was instructed to keep away from each

other, to wash hands and mouth many times, in a day, use sanitizer and not to shake hand and embrace with each other and wear mask. The sanitizers and soap destroy the thin layer of fat, in which, the virus camouflages itself. It is therefore the most effective measure, for protection from this injurious virus. The collective gathering, such as prayers in the mosques, churches, sports events, classes in educational institutions were suspended and students were sent on holidays. The transport, such as railway, automobiles and aero planes were withheld till this pandemic is eliminated. General public was advised to stay at home rather to roam in the city. By these effective measures, China soon overcome this injurious disease and guided other affected countries for prevention of this disease.

5.2 Preventive Appliances

The masks, made of tissue papers and fine cloth, used for wrapping mouth and nose are widely applied for preventing corona virus to enter in the human body through throat and lungs. Similarly, ventilators are vastly used as preventive appliances. Medical Visors (type of veil) have also been designed and fabricated by the Royal Mint at Llantrisant, South Wales and are already in use by the Royal Glamorgan Hospital. The hospital staff has confirmed that the equipment is effectively protecting their front line staff which treats the patients affected by corona virus. The patients who are affected by corona virus were isolated from the healthy peoples and put in isolation and quarantine (special camps installed for isolation to keep away the infection). They were provided meals and other necessities in their camps and in some countries (China) the robots were used for these provisions.

5.3 Common Effective Fumigants

All the essential places which are used for gathering, such as, mosques, shrines, churches, parks, railway stations, airports, bus stands etc. need to be disinfected by some fumigants to control the pests, bacteria and

viruses. In Pakistan, the chlorine spray has been applied widely at all these places.

5.4 Lockdowns and Curfews

More than a third of the world population is now under lockdown as increasing in number of countries implement sweeping measures for fight the corona pandemic.

Mecca Moazzma and Madina Munwara

The holy grand mosque of Mecca *Moazzma* is always fully packed with Muslim pilgrims from all over the world. But on March 19, 2020 Saudi authorities suspended all prayers at the two main mosques in Mecca *Moazzma* and Medina *Munawara*. Saudi Arabia has more than 1500 confirmed cases and 10 deaths upto March, 2020 (fig. 8 & 9).

Microbiological study: During *Rami*, in Pilgrimage, the *Shaitan* is beaten (*Rami*) by stones in Mina. These stones with other sacred stones from *Hira* cave, *Thaur* cave, *Jabl-ul-Rehmat* and mountain *Uhud* at Madina are subject to microbiological study for suspected corona.

Venice, Italy

With more than 100,000 confirmed corona virus cases and 12,000 deaths, Italy is now Europe's hardest-hit country. Authorities in the country are planning to extend a weeks-long lockdown until at least April 12. Italy's tourism sector, which attracts up to 60 million visitors each year, has come to a standstill.

Imam Reza Shrine, Iran

Iran, the Middle East's worst-hit country, announced a complete lockdown on 28 Mar., 20, some five weeks after reporting its first case. The number of confirmed cases is 44606, and the death toll stood at 2898 upto Mar. 2020. The Imam Reza Shrine in *Mashhad*, which normally attracts 20 million pilgrims each year, has been closed since 17 Mar., 2020.

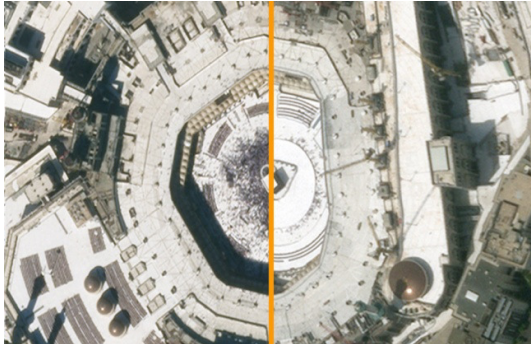
Wuhan, China

Wuhan, where the corona virus was first detected in Dec. 2019 is home to more than 11 million people. The capital of the central Hubei province has been under a mandatory quarantine for more than two months and has

now eased lockdown restrictions. China has reported more than 3300 deaths from 82000 infections upto Mar. 2020.

Disney World, Florida, US

The United States currently has the highest number of confirmed corona virus cases in the world, almost 163000. At least 3000 people have died since the country reported its first case on Jan. 20. On 13 Mar. 2020,



President Trump declared a national emergency.

Fig. 8 Satellite images of Muslim's most sacred *Ka'aba Sharif (Mecca Moazzama)* Saudi Arabia lockdown, as it looks from space, before (L) and after (R). (Source: Al Jazeera and News Agencies)



Fig. 9 General view of *Ka'aba Sharif (Mecca Moazzama)*, Grand Mosque in after Saudi authorities suspended Umrah [File: Ganoo Essa/Reuters]

Copacabana , Rio de Janeiro, Brazil

Brazil was the first South American country to report a corona virus infection on 24 Feb., 2020. Since then, tests of more than 5800 people are declared positive, and 165 have died. President Jair Bolsonaro has repeatedly dismissed a nationwide lockdown and criticized governors and mayors in the country who imposed such measures.

6. CONCLUSION

Like any other manufacturing industries, the workshop environment in foundries comprises many hazardous factors. In spite of some magnificent measures taken to keep the industrial atmosphere free from hazards, health problems of labours working in foundries have not been totally eliminated. Atmosphere of foundries is also prone to the injurious corona virus.

1. A sand moulding foundry generally comprises pattern, moulding, core, fettling, salvaging and reshuffling shops. In all these shops some or other materials and tools are utilized to carry out different jobs:

a) **Pattern shop**, wooden piece is cut in the shape of the casting to be used as a 'pattern'. Wood surfaces are virus proof because of microstructure of wood and the presence of antimicrobial substances. However, to avoid the risk, the surface disinfection is recommended (Domig K, Wimmer R, 2020).

b) **Moulding shop**, the mixture of silica, clay, bentonite, water and molasses is generally used for packing sand in the cope and drag and preparing the mould cavity for pouring the liquid metal. In the core shop the sand cores made of silica sand and core oil or some other special additives are baked and fixed in the mould cavity as per requirement of the casting.

c) After **solidification** of the casting, it is shacked out and fettled & salvaged. The debris are removed.

2. In order to avoid the risk of corona virus for the labour working in these shops, it is necessary to take following measures for labour safety:

a) In **pattern shop**, the pattern maker touches the log from which the pattern is made. The surface of wooden log is highly polluted. The pattern maker must wear the mask and every tool being used by him should be sanitized.

b) In **moulding shop** the atmosphere have dust, fine silica, iron oxides, metallic powder and fumes of different gases

ejected by the sand mould. The labour makes the mould by mixing different ingredients with hands. All these ingredients are suspected to have viruses and bacteria because most of them, such as natural bonding sands, clays are fetched from the beds of lakes and rivers, which are highly polluted. The other special additives such as, molasses, dung, wood flour, iron oxide etc. are sold openly. Every labour who works on the mould line should wear the mask and gloves and sanitize everything which they use. The best measure to avoid the risk of bacteria and viruses of these ingredients is to use moulding machines, such as jolt machines, squeezing machines and automatic conveyer belts for transportation of moulds.

c) In **fettling shop**, the casting is subjected to sand or grit blasting for surface cleaning. The labour working in this zone should wear mask, helmets and sanitize their hands and everything which touches the casting.

3. In modern foundries, all above mentioned jobs are carried out automatically. These automatic foundries are now in-use in all most all the countries. These employ very few workers; consequently they need less care for labour's protection. Therefore a contaminant free and virus free healthy atmosphere in working zone of foundry can effectively be obtained in automatic foundries. Despite the ongoing automation of foundry processes, especially small and medium sized enterprises still perform multiple operations in a manual manner.

4. Foundries have high injury rates, with the largest percentage of injuries attributed to strain and sprains. Training in ergonomics, in combination with engineering and administrative controls, is an accepted path to reducing these types of injuries.

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