TECHNICAL STATEMENT ZHL/GT/004

TECHNICAL CASE FOR THE DEPLOYMENT OF 'Z71 MICROBE SHIELD' ON PASSENGER TRAINS SERVING THE UK RAIL INDUSTRY

DATE OF ISSUE: 19TH JANUARY 2021

MR J MCCLEARY – GENERAL MANAGER - ZOONO HOLDINGS LTD

1. Introduction

GTECH Strategies Limited received an instruction from Zoono Holdings Limited to compile an independent overview providing a current real-world environment study within the UK rail industry, for the Zoono product 'Z71 Microbe Shield'. This was to include the following scope:

- An outline of the reasons why 'Z71 Microbe Shield' was considered superior to the use of standard surface disinfection products within the UK chemicals market.
- Technical evidence used to support the decision and subsequent testing regimes employed to monitor efficacy.

The work was carried out under ZHL Purchase Order No. JM120121.

2. Background

GTECH Strategies Limited has served as a principal scientific consultancy to the UK rail industry since 1997 and provides a range of technical support services to engineering, depot and train presentation departments.

Train fleet operators are uniformly confronted by the following difficulties when scheduling cleaning of their rolling stock:

- The routes that trains follow frequently mean they usually do not return to maintenance depots more than once per month (sometimes longer).
- Frequently trains that do return to depots are required for scheduled engineering maintenance and therefore are not available for cleaning operations.
- Train fleet sizes are only sufficient to provide the passenger service required with a small float of additional trains to facilitate engineering maintenance and cater for unexpected failures.
- Other stabling points (e.g. sidings, stations) are not equipped with adequate water and drainage to allow cleaning to proceed.

Consequently, the frequency that trains undergo scheduled deep cleaning ranges between 20-60 day cycles (dependent upon the operator and geographical location). Trains do receive further interim cleaning on 1-6 day cycles (again dependent on operator/location) but this is rarely more than spot cleaning and dealing with any obvious soiling issues.

In April 2010 a need was identified by several rail clients, working with GTECH Strategies Limited, to examine product options and strategies to deal with a viral pandemic, should such an eventuality ever arise. Since that time, GTECH Strategies Limited has maintained a watching brief of developments within the chemicals industry for new and innovative products that could assist in dealing with a pandemic, should one arise.

3. Standard Surface Disinfectants

The annual market reviews conducted between 2010-2014 by GTECH Strategies Limited revealed only one option; namely the use of normal surface disinfectants. All such disinfectants provide microbicidal activity in a similar way:

- The product is diluted to the recommended concentration - or used as supplied, if in a 'ready to use' (RTU) form.
- The diluted product is introduced by either sprayed or wiped application to leave the treated surface wet.
- A contact time is allowed to elapse, during which the active ingredients in the product kill the micro-organisms present.
- The surface is either allowed to air-dry or is rinsed (dependent upon manufacturer's instructions).

Normal surface disinfectants have the following drawbacks to train operators:

- Whilst normal surface disinfectants are demonstrably microbicidal, they only remain active whilst they are in contact with the surface being treated. A train re-entering service after treatment could become re-contaminated immediately it encounters an infected person.
- Daily disinfection of surfaces is not logisitically possible for the reasons outlined in Section 2.

A global pandemic presents the need for train operating companies to have an optimum method of protecting the travelling public from the spread of infectious diseases, whilst working within the constraints of its operational obligations and logistic restraints (see Section 2).

4. Z71 Microbe Shield

The annual review of market options by GTECH Strategies Limited in 2015 revealed the presence of 'Z71 Microbe Shield', offered in the UK by Zoono Holdings Limited. Interrogation of the supplier revealed the product to be new and innovative, being based on Siloxane-Quat technology. The rail industry had already had exposure to other ultra-thin film silicon compounds which had been deployed successfully to improve graffiti resistance and cleanability of vulnerable or worn surfaces respectively.

A test report by Eurofins New Zealand (Ref. 14NZAK0020190; dated 13/3/14) was provided by Zoono which indicated that, under the bespoke laboratory test conditions, 'Z71 Microbe Shield' had demonstrated residual microbicidal properties on treated surfaces for 28 days.

Consequently, during August - September 2015, GTECH Strategies Limited scoped and project managed a trial in collaboration with London Underground Limited and Zoono. The trial involved the grab poles/grab rails throughout 4 train carriages being lightly cleaned with normal detergent and treated with 'Z71 Microbe Shield' by wiped application. The carriages entered service and

were exposed to normal operating conditions over a 25-day period, which would have included daily spot cleaning (as and when required) and one 21-day deep cleaning cycle.

After the 25-day period, swabs were taken from the grab poles on the treated cars and a similar number of untreated cars; these were sent to the independent test laboratory Eurofins Scientific, where agar plates were prepared on petri dishes, incubated for 48 hours and counted for active microbe colonies. The results revealed the following:

- All swabbed grab poles on treated cars were classifiable as 'near sterile' (i.e. Total Viable Colony counts of <10 in all cases).
- Of the untreated grab poles, the swab test results were as follows:
  - 20% were classified as 'grossly contaminated'.
  - 45% were classified as 'contaminated'.
  - 35% were classified as 'near sterile'.

The success of this trial was fully reported; and the information held as an option should a global pandemic ever arise. Since that trial GTECH Strategies Limited has been provided with further reports by Zoono relating to bespoke testing that indicated residual microbicidal activity was being demonstrated by the 'Z71 Microbe Shield' product.

5. The Covid-19 Pandemic

The sudden occurrence of the new coronavirus strain, Covid-19, quickly developed into a pandemic, with the general public being understandably concerned about its impact upon health. A few specific facts about Covid-19 were widely reported in national media and scientific journals:

- The primary methods through which the virus spreads are:
  - During close contact with an infected person.
  - From small droplets produced when an infected person coughs, sneezes, or talks.
  - Touching a surface that has been contaminated with the virus and then touching the face, nose or eyes (the virus absorbing through mucus membranes).
- The virus can survive on surfaces for up to 72 hours, if untreated.
- Covid-19 is classed as an 'enveloped virus' (influenza strains, HIV, Hepatitis A, B, C & D, SARS and MERS all being categorised similarly).
- Its dwell time on surfaces is similar to other enveloped viruses and shorter than many bacterial entities and 'non-enveloped' viruses.
- As an 'enveloped virus', Covid-19 is easier to sterilize on surfaces than 'non-enveloped' viruses (e.g. Norovirus, Hepatitis E) and similar to other widely occurring bacteria (e.g. Staphylococcus Aureus, E Coli); therefore it would be expected to be killed by most standard surface disinfectants from reputable suppliers.
- The primary concern with Covid-19 is its rate of spread and the fact that humans do not, generally, have antibodies that can resist its modes of infection.

Documentary evidence concerning 'Z71 Microbe Shield' was provided by Zoono indicating the following:

- Microbiological Solutions Limited (Report No. J001347; dated 27/2/20) reported the product had satisfactorily met the requirements of EN 14476: 2013 + A2 2019 (tested against the feline coronavirus surrogate, which is normal practice for this test standard).
- ERM Regulatory Services Limited Letter, dated 29/8/19 confirmed that 'Z71 Microbe Shield' satisfactorily met the requirements of Article 89 of Biocidal Product Regulation; EU Regulation 528/2012. GTECH Strategies Limited has noted that this would have validity until 28th August 2022, when a full suite of test data would be required.

6. Deployment since April 2020

6.1 Technical Assurance Cases and Task Cards

Since the onset of the Covid-19 pandemic, several major train service operators have all contacted GTECH Strategies Limited to assist in compiling their technical assurance cases thus enabling them to deploy 'Z71 Microbe Shield' within passenger saloons and drivers' cabs of their rolling stock.

The technical assurance cases compiled by GTECH Strategies Limited covered:

- A consideration of health, safety & environmental impacts.
- A fitness for purpose assessment by an independent rail industry-oriented laboratory.
- Microbicidal efficacy data.
- Case study data from the 2015 trial (see Section 4).
- Prevailing fire performance standards.

GTECH Strategies Limited also compiled comprehensive Task Cards for each specific fleet operated by the rail company concerned, which covered:

- Identification of all high-risk contact points within the passenger saloon and drivers' cab areas. This was presented on annotated photographs with each high-risk contact point clearly designated.
- Cleaning agents and methodologies for preparing train surfaces prior to the application of 'Z71 Microbe Shield'.
- Preparation of fogging equipment (where used) for application of 'Z71 Microbe Shield'.
- Methods of application of 'Z71 Microbe Shield' by fogging or manual application (as required by each specific train company).

6.2 Deployment Decisions

It has been noted that the laboratory microbicidal efficacy tests outlined in Section 5 were all bespoke. However, as a new and innovative product, literature searches conducted by GTECH Strategies Limited confirmed that there were no British Standard or Euronorm tests capable of determining efficacy for a product that was demonstrating residual microbicidal activity on treated surfaces in the reported laboratory tests. Consequently, the rail industry case study (see Section 4) that confirmed such activity was technically achievable was accepted by rail operators as being indicative of a product capable of providing a higher level of protection than simply treating with normal surface disinfectants.

The final decision to deploy any material is the responsibility of the train operating company concerned. Consequently, all information, documents and data submitted in relation to 'Z71 Microbe Shield' were subjected to their own mandatory technical assurance and change documentation procedures.

Since April 2020, several rail companies (including the largest subway operator and the largest franchised overland passenger rail operator) made the decision to deploy 'Z71 Microbe Shield' in the passenger saloons and drivers' cabs of all their rolling stock.

6.3 Swab Testing Since Deployment

GTECH Strategies Limited has continued to support train operating companies to establish whether the 'Z71 Microbe Shield' treatment is providing the necessary protection of surfaces against micro-organisms. Since mid-July 2020, swabbing of trains for Coronaviruses, E Coli and Staphylococcus has been conducted by GTECH Strategies Limited in collaboration with an independent UKAS accredited test laboratory (which undertook testing as follows):

- Coronavirus screening (PCR test) and identification of SARS-CoV-2 for positive PCR tests.
- Quantitative evaluation for E Coli and Staphylococcus (results reported as Colony Forming Units (cfu) per swab.

Swab sampling has been undertaken as follows:

- 128 high risk contact areas have been swabbed on 26 service trains.
- The minimum surface area swabbed for each sample was 100cm^2.
- High risk contact points were always chosen for swabbing as follows:
  - Left hand grab pole in door vestibule areas. This is a critically important area for sampling as passengers frequently stand in door vestibules for the last few kilometres of their journey and steady themselves on this grab pole (as the effect of the train braking tends to throw them forwards).
  - Buttons and handles on train toilet compartments.
  - Dead mans handles in driver's cabs. This item is always in contact with the train driver's hand whilst the train is in motion.
- Trains had been in normal passenger service for between 7-30 days since the most recent application of 'Z71 Microbe Shield'.

A summary of the results obtained is as follows:

- No presence of Coronaviruses detected in any of the 128 high risk contact areas tested.
- No presence of E Coli detected in any of the 128 high risk contact areas tested.
- No presence of Staphylococcus detected in 126 high risk contact areas tested.
- Readings of 10 cfu and 20 cfu respectively for Staphylococcus on two toilet door handles – both readings occurred on the same day for a train that had received its first application of 'Z71 Microbe Shield 7 days earlier. These cfu readings are too low to be considered significant.

GTECH Strategies Limited comments that there has been very limited opportunity for funding to conduct comparative testing on trains that have not been treated with 'Z71 Microbe Shield'. However, one rail operator has funded swab testing for Coronavirus on 36 high-risk contact points across 6 trains. In this limited study, one passenger area was identified by PCR to have Coronavirus present, which was also positively identified as SAR-CoV-2.

6.4 Micro-Organisms within the Public Transport Environment

Data from two relevant published studies are available as points of comparison:

- A study entitled 'Bacterial contamination on touch surfaces in the public transport system and in public areas of a hospital in London' [1] found median levels of all bacteria of 12 cfu/cm^2 with recorded values ranging between 0 – 250 cfu/cm^2. This would equate to an expected median value of **120 cfu per swab** for the studies undertaken by GTECH Strategies Limited since each area swabbed was a minimum of 100 cm^2.
- A study entitled 'A diversity of Antibiotic-resistant Staphylococcus in a Public Transportation System' [2] undertaken in Portland, Oregon found levels of this organism in 8 cm^2 as follows:
  - 97.1 cfu on bus and train floors
  - 80.1 cfu in cloth seats
  - 9.5 cfu on handrails,
  - 3.8 cfu on the underside of seats
  - 2.2 cfu on windows
  - 1.8 cfu on vinyl seats

If extrapolated to the sample sizes of 100 cm^2 used by GTECH Strategies Limited in the rail industry studies, the above results would need to be multiplied by 12.5.

References:

1. Otter, J. A. and French, G. L. (2009) Bacterial contamination on touch surfaces in the public transport system and in public areas of a hospital in London. Letters in Applied Microbiology. 49, 803-805.
2. Yeh, P. J., Simon, D. M., Millar, J. A., Alexander, H. F., and Franklin, D. (2011) A diversity of Antibiotic-resistant Staphylococcus spp. in a Public Transportation System. Osong public health and research perspectives, 2 (3), 202-209.

7. Conclusion

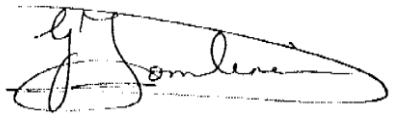
In working to satisfy the technical needs of its rail industry clients, GTECH Strategies Limited has necessarily had to engage with the Zoono organisation (both its UK and New Zealand operations). The responses received have been swift, comprehensive and satisfactory.

Clearly the 'Z71 Microbe Shield' product is technologically new and innovative. However, the claimed performance of providing residual microbicidal activity is being demonstrated via the growing body of case study evidence that has been generated within the UK rail industry. In particular, the swab testing results reported in Section 6 indicate that:

- 'Z71 Microbe Shield' is efficacious on high-risk contact points on normal service trains that have been in service for 7-30 days since the last occasion the product was applied to surfaces in passenger saloons and drivers' cabs (see Section 6.3). Protection against the presence of Coronaviruses, E Coli and Staphylococcus has been clearly established.
- This data is further enhanced when considered in the context of the previous studies undertaken in the public transport environment (see Section 6.4).

GTECH Strategies Limited is of the view that further laboratory testing of the product would be highly beneficial in proving the residual microbicidal activity beyond all reasonable doubt. However, there would need to be engagement from both commercial laboratories and the agencies that set test standards in order to design a suitable test programme that would be capable of accurately and reproducibly assessing residual microbicidal activity in a laboratory setting.

Without such a test standard being available there has been a pressing need for the rail industry to mobilise its services during the Covid-19 pandemic. In achieving this goal, some train operating companies have adopted the principle of 'best endeavours' to treat high-risk contact points within trains with 'Z71 Microbe Shield'; the product appears to offer a higher level of protection than that developed by normal surface disinfectants and is compatible with the logistic and operational constraints of providing the train service and maintaining the trains in the depot environment.



Graham Tomlinson JP BSc (hons) CChem FRSC
Technical Director

Footnote

The information contained in this report has been commissioned by Zoono Holdings Limited.

GTECH Strategies Limited is an independent scientific consultancy and undertook the investigation impartially and has highlighted all pertinent issues that arose.

This report has been compiled by me, Mr Graham Tomlinson, Technical Director of GTECH Strategies Limited with the following technical assurances:

- Batchelor of Science honours degree in Applied Chemistry from Brunel University.
- Professional status of Chartered Chemist and Fellow of The Royal Society of Chemistry.
- 34 years of industry experience having worked in research & development, production, product management and, since 1994, in scientific consultancy within the transportation industry.