Prevention and prediction drive new solutions

IN SHIPBOARD FIRES PREVENTION IS BETTER THAN CURE. WHILE FIRE-MITIGATING TECHNOLOGY IS ADVANCING ON ALL FRONTS, IMO IS GETTING TOUGHER ON INSPECTION AND MAINTENANCE

BY SELWYN PARKER

There are still too many shipboard fires, says IMO. Fires on board passenger ships, and especially on roro ferries, occur far too frequently, according to a series of studies by IMO safety experts. They cite a total of 73 fires on roro passenger ships between 1994 and 2011.

And, of course, others have happened since then. One of the most recent was a ferry, *PeeJay V*, which caught fire just off the New Zealand coast in January 2016 and burned down to the waterline. Fortunately, none of the 57 people on board died.

IMO concludes: "There have been a number of significant fire incidents on roro passenger vehicle decks since 1994 and there is no sign of these diminishing. Since 2002 there has been a very serious incident every other year, resulting in six constructive total losses."

According to IMO's investigations, these fires were triggered by a variety of causes ranging from electrical problems in parked vehicles to engineroom events. The blaze on *PeeJay V* is thought to have started in the galley. But, disturbingly, follow-up analysis revealed that failures in the maintenance and inspection of fire-fighting tools such as sprinklers contributed significantly to the frequency of fires. Once they had started, the fires were not contained as rapidly as they should have been.

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Although IMO's overriding consideration is human life, there is also a commercial imperative involved in fire prevention. The cost of an onboard fire is put at around US$200,000 a minute.

As a result of its findings IMO is cracking down on operators and demanding more frequent inspections and documented evidence of routine maintenance. The safety authorities are particularly concerned about older ships. "Consideration should be given to identifying improvements that can be made to the fire-protection standards applied to roro passenger ships constructed before 1 July 2010 to enhance their survivability and safe return

to port in the event of a vehicle deck fire," a 2014 report noted, pointing out that such vessels could remain in service for the next 20 years or more.

A test on Bahamas-registered vessels supported IMO's concerns. It revealed an alarmingly high failure rate of automatic sprinklers on passenger ships – in some cases more than 50 per cent. The importance of the reliability of sprinklers is obvious. A typical passenger ship will have as many as 6,000 sprinklers in accommodation and service areas.

The resulting warnings highlighted the value of disciplined inspection and maintenance. As one report noted, interim fire-safety measures must immediately be put in place when thorough testing reveals high failure rates. "These [measures] comprise increased fire patrolling activities and procedures where, in the event of a confirmed fire, the automatic sprinkler system may be started remotely from the bridge and operated at maximum operating pressure," the authors said.

The contradiction is that while failures in routine maintenance lie behind many fires, the fire-prevention industry is devising increasingly clever solutions to prevent events – or at least reduce the damage from them. Water mists, for example, are becoming more powerful and faster-acting, as in the case of Finland-based Marioff Corp's latest HI-FOG 3000 system launched in early 2015.

As soon as the ambient temperatures hit a pre-designated threshold, the bulb breaks and a continuous spray of water is distributed through concealed pipes, over a wider area than previous models. And because the system uses pure water, it can be activated without any risk to human life. As Marioff points out, the fire-fighting can start without the space having to be evacuated first.

As well as being more powerful, the latest sprinkler systems are more compact. Among other advantages this means they can be easily retrofitted without destroying the aesthetic integrity of cabin interiors. For instance, the HI-FOG 3000 has narrow tubing, and smaller pump units and water tanks. Similarly, the space-saving Minifog Marine XP sprinkler developed by German manufacturer Minimax uses up to 90 per cent less water. Despite this, one unit can protect an area of up to 32m^2.

At the same time, heavy science has gone into the development of passive protection that aims to contain as long as possible the spread of a fire or explosion, but without the need for intervention in the form of sprinklers and other active deterrents. For instance, Promaguard by Belgium-based group Promat is a microporous material that is based on nano-structured, sub-micron, synthetic amorphous silica (SAS).

Combined with other environmentally safe synthetics, SAS particles are formed into long chains that work to block the invasion of solid heat – that is to say, flames. The spaces in the chain are so small that they are able to eliminate the conduction of most of the gaseous heat. Simultaneously, materials known as mineral oxide pacifiers inhibit infra-red radiation.

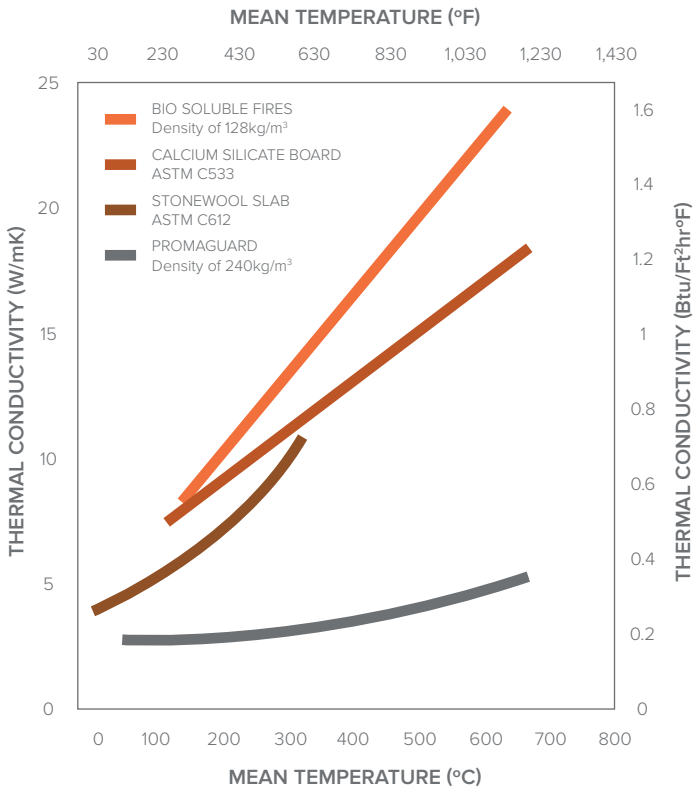
SAS has proved spectacularly successful. Made into light and thin strips of cloth, Promaguard was quickly adopted by the aviation industry where it was applied in places of high fire risk such as the radome, engine and exhaust, and galley. And now it is being used on a wide scale in shipping.

Aiming to beat the Solas A60 fire-rating standards for a ship's safe return to port, Promat developed a year-long project for the marine industry that ended successfully in June 2014. By then a series of stringent, third-party monitored tests had established that 15mm thick layers of Promaguard were able to exceed A60 while Promaguard combined with Ultimate, an Isover insulation product, could keep a fire at bay for nearly four hours. Even better, these gains could be achieved without any time-consuming and costly fire-resistant alterations to the ship's original design.

Promat's Giorgio Lauro, naval architect and marine segment manager, explained that they were able to prolong the period when a fire is prevented from spreading from 60 minutes to 240 minutes by adding only 15mm lengths of Promaguard on top of an existing standard insulation. The company says the layers can be applied with equal effectiveness on aluminium, steel and fibreglass decks and bulkheads. Promaguard is also finding favour in operational areas such as control rooms and offices where drench systems can ruin valuable electronic equipment and intellectual property.

Meanwhile, the engineroom remains by far the most common source of a fire on every kind of vessel including passenger ships, accounting for between 50 and 70 per cent of all fires and explosions. Mohit Sanguri, an authority on fire prevention currently working with Dynacom Tankers Management, pointed out in a recent study: "The engineroom of a sea going ship is a highly fire-prone area." Given that it usually contains tanks that are full of different kinds of hot oils and chemicals, some of which runs

Thermal characteristics of PROMAGUARD®, thickness of 10mm



Third-party tests show how layers of Promaguard suppress thermal conductivity and delay the onset of a fire

through kilometres of piping at pressures as high as 1,200 bar, this is hardly surprising.

While conscientious maintenance of fire-prone areas in the engineroom remains the best prevention – this being the primary responsibility of the fire-safety officer – explosions can be triggered by a variety of less easily detected factors such as material fatigue and failures in automation. Most modern enginerooms bristle with fire-detection systems such as heat, flame and smoke detectors that are monitored from the bridge on a master control panel. Secondary systems are installed in the engineroom. And most enginerooms are equipped with high powered sprinklers.

But the ideal solution is clearly to predict the fire or explosion – that is, before it occurs – and thus head it off. This is the idea behind the US$100,000 LAS-10 system produced by Denmark manufacturer Daspos. Designed for the open enginerooms on big ships, the LAS-10 (leakage alarm system) continuously analyses the atmospheric air for any dangerous density in hazardous oil fumes and gases. If the system detects that densities have reached intolerable levels, it alerts the crew. Validated by the Danish Technological Institute, LAS-10 is being proven on passenger and other vessels.

But if a fire does break out in the engineroom despite precautions, nobody has yet found an alternative to the classic fire extinguisher – albeit much modified. Fast-acting, they are highly effective for dousing localised blazes and explosions before they spread into full-scale conflagrations.

Filled with carbon dioxide (CO_2), dry chemical powder or foam, according to the requirement, extinguishers should be placed at specific points in the engineroom.

And, more traditional again, the sand box remains an effective fire-fighting tool after all these years. First used on vessels that were powered by combustion engines, the sand box is placed near the boiler. If a minor fire breaks out, sand is thrown onto the flames.

But when none of the above work, the last resort is the dedicated CO_2 room where this gas is stored under high pressure. The oxygen-replacing CO_2 is deployed only when the fire has taken hold. Mr Sanguri added: "The CO_2 is released in the emergency situation of a fire out of control, after evacuation of the engineroom by the chief engineer on the order of the master of the ship."

It has not yet been established how to deal with ethanol-triggered fires, which are more likely given the growth in ethanol-powered fleets. "No one really knows what happens in the event of a cistern fire involving ethanol, or how best to extinguish it," reported Björn Sundström, head of the department of fire technology at SP Technical Research Institute of Sweden, in February. But his department is working on it. The laboratory is running a project called Etankfire (ethanol tank fire-fighting) that is studying the special characteristics of an ethanol-triggered blaze. It hopes to come up with some answers shortly.

Finally, IMO's reports highlight a common problem in fire-fighting on board ships—once a blaze starts, things start going wrong. In seven of the 14 cases studied of roro fires, drenchers were unsuccessful or partially successful. In the *Lisco Gloria* fire in October 2010 the system did not deliver any water at all. And when *Vincenzo Florio* went ablaze in July 2004, a power black-out delayed the activation of the foam fire-fighting system installed on the vehicle decks. As a result the blaze raged for ten days.

If US$200,000 a minute is a reliable estimate of the damage a fire causes, it is not surprising that *Vincenzo Florio* required extensive repairs. PST

73 FIRES

ON RORO PASSENGER SHIPS BETWEEN 1994 AND 2011

SINCE 2002 THERE HAS BEEN A VERY SERIOUS INCIDENT EVERY OTHER YEAR, RESULTING IN **SIX CONSTRUCTIVE TOTAL LOSSES**

THE COST OF AN ONBOARD FIRE IS PUT AT AROUND

US$200,000 A MINUTE

A TEST ON BAHAMAS-REGISTERED VESSELS REVEALED **A HIGH FAILURE RATE OF AUTOMATIC SPRINKLERS ON PASSENGER SHIPS** – IN SOME CASES MORE THAN 50 PER CENT.

THE ENGINEROOM ACCOUNTS FOR BETWEEN **50 AND 70 PER CENT OF ALL FIRES** AND EXPLOSIONS ON ALL TYPES OF VESSELS

IN SEVEN OF THE 14 RORO FIRE CASES STUDIED, DRENCHERS WERE UNSUCCESSFUL OR PARTIALLY SUCCESSFUL (IMO REPORT)

Promat's project showed that it was able to prolong the period when a fire is prevented from spreading from 60 minutes to 240 minutes