

eureka

Issue 24

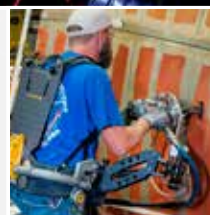
Spring
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THE MAGAZINE FOR THE MATERIALS HANDLING PROFESSIONAL

Exoskeletons

Are wearable materials handling structures a realistic possibility or pure sci-fi fantasy?



Hazardous atmospheres

Legislation and extreme forklift truck proofing for explosive situations



Safer loading docks

Scanning the market for technological aids to reduce risks



eureka issue 24

The magazine for the materials
handling professional

Spring is in the air, and as we welcome you to another issue of **eureka** we hope that the first few months of 2015 have seen fresh growth and success for your business.

One of our continuing missions is to bring you information on technologies developed to boost your productivity, improve health and safety or support your operation in any other way. Looking far into the future, sci-fi films suggest that materials handling could one day be accomplished by wearing an exoskeleton that gives the user superhuman abilities. As **Robin Meczes** tells us, this technology is not just a sci-fi fantasy.

Back to the present, **Ruari McCallion** enters the danger zone to find out about some of the most extreme environments facing forklift trucks. Along with the obvious hazardous materials, there are others which in certain conditions can become dangerous or even explosive. Our feature looks at the legislation governing such situations and at how forklifts can be modified to cope with atmospheric challenges.

An essential requirement of any successful business is a healthy and effective workforce. **Mark Nicholson** returns to one of the focal points of health and safety attention, the loading docks, to see what today's technology has to offer in reducing risks.

Finally, we raise a productivity issue that many businesses may not yet have considered. Is the way in which you are storing and handling diesel fuel affecting the performance of your forklift trucks – and could it be threatening serious damage to these vital assets? **Mark Nicholson** gives us an introduction to this complex topic.

We would love to hear your views on **eureka** and to know if you have stories of your own that we can investigate. You can email us at comment@eurekapub.eu or contact us via our website www.eurekapub.eu.



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eureka's commissioning editor is **Monica Escutia**, a Bachelor of Communications – Journalism. She is a Spanish national and fluent also in Dutch, English and Italian. Having previously edited a variety of international media she has spent the last 13 years in the materials handling industry – the first four as a parts sales representative for several European countries, before becoming the EAME Manager Marketing Communications for Cat Lift Trucks, based in the Netherlands.

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Exoskeletons
The perfect body

Could wearable outer frames like the 'power loader' worn by Sigourney Weaver's character Ripley in *Aliens* really have a part to play in the future of materials handling? Robin Meczes investigates the subject of exoskeletons and finds there is scientific fact as well as science fiction behind such technology.



8-10

Health & Safety
Extreme sensitivity

Forklift trucks are called upon to operate in all sorts of challenging environments, some of which are literally explosive. Ruari McCallion looks at a range of atmospheric hazards, summarises the key safety legislation and describes how trucks are prepared for working lives in the danger zone.



11-13

Loading dock technology
In search of automatic solutions

Loading docks are commonly described as the most dangerous part of a warehouse, distribution centre or factory. Awareness, training, legal compliance and a strong culture of safety are essential here, but what can technology do to help? Mark Nicholson presents a variety of 'safety nets' available on the market.



14-15

Diesel fuel quality
Tackling chemical effects, water and microbes

Stored diesel fuel is affected by chemical breakdown, contamination by water and infestation with microbes. At best, use of 'bad' diesel lowers forklift efficiency. At worst, it will block filters and cause damage to engines and other components. Mark Nicholson outlines the problems and their solutions.

Events Calendar

Date, Event, Location, Website	Overview
19 - 23 May 2015 INTRALOGISTICA ITALIA 2015 Fieramilano, Milan - Italy www.intralogistica-italia.com	<i>Intralogistica Italia</i> is a new exhibition dedicated to the most innovative solutions and integrated systems for industrial handling, warehouse management, storage of materials and picking. Due to its location in Milan and the in-depth level of exhibitors, the new show fills a void in the Italian fair panorama, offering visibility at the same time to the entire handling sector which is particularly strategic for economic development and to the Italian intralogistics market. Throughout the event there will be many opportunities for discussion and workshops in collaboration with industry experts and international industry associations that will enrich the exhibition with useful updates on trends in materials handling, logistics and intralogistics.
9 - 11 June 2015 TOC CONTAINER SUPPLY CHAIN: EUROPE Ahoy, Rotterdam, Netherlands www.tocevents-europe.com	The <i>TOC Europe</i> is the global meeting place for ports, terminals, shipping lines, 3PLs & shippers. The exhibition is a showcase for port and terminal technology and operations and the conference focuses on collaboration within the container supply chain. Featuring over 160 companies from around the world, the <i>TOC Europe Exhibition</i> is the undisputed global showcase for the latest in port operations, equipment and technology solutions.
9 - 11 June 2015 SIL 2015 Fira de Barcelona Montjuic Exhibition Center, Spain www.silbcn.com	The 17th SIL edition presents its slogan "Number 1 in Logistics" that stresses the leadership of the <i>International Logistics and Material Handling Exhibition</i> , which last year counted with a 45% of international companies. At the same time, year after year, <i>SIL</i> generates a large volume of business for those companies participating in the event and it works for making them to obtain the maximum profitability.



"It was Archimedes who observed that the power of levers could be used to move the entire world." This publication is named after his famous exclamation of '**eureka**!', literally, 'I've found it.'

THE PERFECT BODY?

Exoskeletons – wearable structures that give the human body greater abilities – appear to be developing fast. So could such technology be the next great step forward in terms of materials handling?

Robin Mecztes investigates.



1. Lockheed Martin's unpowered FORTIS exoskeleton takes the weight of a load like a heavy hand tool off operators and is currently under test with the US Navy.

It sounds like the stuff of science fiction – a wearable outer frame that increases your strength, range of movement and stamina, while allowing you to move much as normal. And such technology has certainly featured heavily in the world of sci-fi films in recent years, from the 'power loader' worn by Sigourney Weaver's character Ripley in *Aliens* to the robot-like, full body suit protecting Robert Downey Jr in the *Iron Man* series.

But such technology is far from just a sci-fi fantasy.

A number of exoskeleton devices have already been developed, mostly consisting of a battery-powered metallic or composite frame controlled by electronics which 'read' the movements a person is trying to carry out and then control the frame to provide mechanical assistance.

Up to now, the major target markets for such technology have been military and medical. In the military, the technology could help troops carry greater loads for longer and reduce their levels of fatigue; in medical terms, meanwhile, such devices are already being used to help injured or disabled people learn to move again.

It's an exciting area and one which has the potential to filter down into everyday use in time. So are exoskeletons likely to become the handling equipment of choice in industrial applications in the near future?

A helping hand

One area where such technology could certainly provide a major boost is in manual

handling of relatively small loads – an activity that has been the cause of many minor and not-so-minor injuries over the years and where reducing or even eliminating the physical effort required would clearly be a great step forward, helping to keep workers injury-free and potentially making them more productive.

Already, lightweight exoskeletons of exactly this kind exist, most notably Lockheed Martin's recently unveiled FORTIS – an unpowered exoskeleton designed to take the weight of a load like a heavy hand tool off operators while they work. The firm suggests its technology, which has recently won a number of design awards and is currently under test with the US Navy, can result in productivity increases of two to 27 times.

"Exoskeletons are changing the way we look at performing certain jobs," commented Keith Maxwell, Lockheed Martin exoskeleton technologies capture manager at the time of FORTIS's launch. "By introducing exoskeletons to the industrial environment, we're opening the aperture for where they can be used and how they can enable workers to be more productive with less fatigue or strain."

Bigger loads

What's not so clear at this stage is whether exoskeletons could ever take over the job of moving heavier loads, like a one-tonne pallet. Most of the systems in development today offer relatively restricted lift capacity and since most have been designed to be lightweight and portable, it's debatable how soon and how far their lift capacity can realistically be increased.

"Currently, we support the weight of a human being up to 220 pounds in our medical device by transferring the weight to the ground. Applying the same principles, one can envision moving a significant amount of load in the near future"

US firm Ekso Bionics, whose technology is used by Lockheed Martin's FORTIS and whose own Ekso GT battery-powered exoskeleton, which is designed to help people walk again, has been commercially available for three years, suggests the lift capacity of such systems will soon rise, however – though it doesn't say how far.

Heidi Darling, a spokeswoman for the company, told eureka: "Currently, we →



Visit:
Ekso Bionics



2. Ekso Bionics' GT battery-powered exoskeleton, which is designed to help people walk again, has been commercially available for three years.



See the
Lockheed Martin HULC
in action

3. The HULC with lift assist device, allows one soldier to lift loads, maintains normal lifting range of motion and keeps the center of gravity close to the soldier.

support the weight of a human being up to 220 pounds [around 100 kg] in our medical device by transferring the weight to the ground. Applying the same principles, one can envision moving a significant amount of load in the near future."

The firm also believes its technology is suited to a range of non-medical applications including industrial ones, she confirmed. Current technology, she said, was "only the beginning of a myriad of possible uses that require both strength and skill".

Much will depend on the practicality of any power source such exoskeletons use, of course, but here again, the future is promising, suggested Darling. "We are on the brink of substantial reduction in battery size for a high amount of power provided, as well as in the midst of development of other functional power sources such as solar or hydrogen cells," she pointed out.

End of the lift truck?

Even if exoskeletons do eventually offer more load capacity and sufficient power to suit industrial shift patterns, the big question for logistics managers is whether they will offer any benefits beyond those already incorporated in today's handling equipment.

This is a key issue because while today's ride-on lift trucks obviously depend on wheels, rather than mechanical legs, they are otherwise quite similar to exoskeletons, being designed to fit snugly and comfortably around an operator while substantially increasing their strength and range of movement.

Allowing a single human operator to lift loads from 1 to 16 tonnes – some of these to heights of up to 11 metres – today's lift trucks offer amazing performance that far exceeds the capabilities of even the most ambitious exoskeleton concept to date.

Designed around the human operator, they also offer levels of comfort and control that are hard to rival, with ergonomically designed interiors and controls that keep operators comfortable and allow them to work for periods of several hours at a time.

Like many exoskeletons, today's lift trucks also feature sophisticated management electronics and with a range of proven power sources, the versatility of numerous bolt-on handling attachments and the ability to work in some of the harshest possible environments – including dirty, dusty, wet, cold or hot ones – it is little wonder these trusty workhorses have been at the centre of industrial handling operations for decades.

While exoskeletons undoubtedly have an exciting role to play in the future, they are – for now at least – nowhere near equalling the performance, availability or affordability of what we have right now in the modern forklift truck.

but even here, it remains to be seen whether the benefits they offer can be made financially attractive to business users, practical from a power supply and maintenance point of view, or even acceptable to the workforce required to wear them (remember the fuss about workers becoming 'robots' when wearable, wrist-mounted order picking terminals first came in?).

For now, therefore, it seems likely the pivotal role of the lift truck in modern logistics operations will not change for many years and that exoskeletons will be used only where their exceptional ability – that of automatically accompanying the user wherever they may go – is truly called for. ■

Article feedback is welcome: editor@eurekapub.eu



Find out more about
Lockheed Martin FORTIS

Other exoskeleton developments

Apart from Lockheed Martin's FORTIS and Ekso Bionics's Ekso GT, several other exoskeletons of note have been developed in recent years.

They include the HULC (Human Universal Load Carrier) which was first unveiled by Ekso Bionics in 2008 and licensed to Lockheed Martin the following year for military development. Lockheed Martin went on to produce a ruggedised prototype full body exoskeleton designed to help soldiers carry more and move more efficiently, said to be resistant to sand, wind and rain, as well as extreme temperature and humidity – useful attributes in both theatres of war and many harsh industrial environments.

Japanese developers, too, have been busy with this technology. Cyberdyne's HAL (Hybrid Assistive Limb), for instance, is another robotic suit designed for therapeutic and fitness purposes which is just going through an approval process for use as a medical device in the US; while another Japanese firm, ActiveLink, has developed the closest thing yet to Ripley's power loading arms in Aliens with the aptly named Dual Arm Power Amplification Robot, which measures the magnitude and direction of the force applied by the operator and allows them to 'feel' through the arms via Direct Force Feedback.

Even students have been getting involved in this arena, with a group at the University of Pennsylvania recently developing the Titan Arm, a backpack-based powered upper body device for rehabilitative applications and occupations requiring augmented strength. The team behind the device, which says it can easily support 25 kg loads, has been nominated in the 2015 Edison Awards, which seek to recognise new product innovation.



Find out more about
Cyberdyne



Visit: titanarm.com
and see more



See more information
about ActiveLink



"Today's lift trucks offer amazing performance that far exceeds the capabilities of even the most ambitious exoskeleton concept to date"

Where the new technology does seem a more realistic proposition is in manual handling operations – imagine the productivity boost exoskeletons could provide in carton stacking or vehicle loading applications, for instance –

4. The advanced ergonomic design of FORTIS moves naturally with the body and adapts to different body types and heights.



Extreme sensitivity

Preparing forklift trucks for operation in extreme and dangerous environments is a job for professionals.

Ruari McCallion has received some guidance from Pyroban on regulations and appropriate modifications.

PYROBAN®



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www.pyroban.com

Cat® Lift Trucks can confidently say that its trucks are suitable for most normal materials handling circumstances, but there are situations where special treatment is necessary.

Chemicals and explosives are obviously hazardous, as are industrial gases, for example, but even everyday items such as foodstuffs or drinks can also be dangerous. In the right – or rather, wrong! – conditions, even baking powder and flour can be explosive. If customers are operating in dangerous or challenging environments, then help and advice is at hand.

“There is an extensive array of legislation within the European Union that covers hazardous materials and dangerous environments, along with the measures that are required to manage them and

make them safe,” said Matthew Shirkie, Industrial Commercial Manager, EMEA, with Pyroban. Other countries have their own regulations and some – such as China’s – can require modifications over and above Europe’s.

“The EU’s legislation is under two ATEX (Atmosphères Explosives) directives: ATEX 1999/92/EC, which covers industries that operate with potentially explosive atmospheres; and ATEX 94/9/EC, which deals with industries that supply equipment into hazardous areas.”

The two directives have been applied in individual EU states under national laws; DSEAR (the Dangerous Substances and Explosive Atmospheres Regulations), for instance, is the United Kingdom’s implementation of ATEX.

Avoid bright sparks

Some of the requirements look like basic, sensible precautions – for example, **ATEX 1999/92/EC** requires companies to prevent the formation of explosive atmospheres in the workplace, or (where this is impossible) avoid the ignition of explosive atmospheres. But what the regulations do is to provide a framework and lay out clear common standards, which apply across the EU.

While some materials will be recognised as potentially hazardous to handle even by lay people and non-experts, some are not so obvious.

“The danger with flour, for example, is that fine particles of it can be explosive if suspended in the air in a confined space. A simple spark from an electric lift truck can set off a catastrophic explosion,” said Shirkie.

“The first step in avoiding disaster and ensuring a safe working environment is the completion of a ‘hazardous risk assessment’. This will cover the likelihood of explosive atmospheres and any source(s) of ignition. A systematic review will identify, and classify into zones, areas within the premises where potentially explosive atmospheres exist.”

“The danger with flour, for example, is that fine particles of it can be explosive if suspended in the air in a confined space. A simple spark from an electric lift truck can set off a catastrophic explosion.”

The zones themselves will identify the standard of certified equipment to be installed within them. They are: **Zone 1** (high risk gas/vapour); **Zone 2** (medium risk gas/vapour); **Zone 21** (high risk powder/dust); and **Zone 22** (medium risk powder/dust). [See Hazardous Area Classification chart]

‘Effective ignition sources’ – i.e. things that could initiate explosions – range from open flames and lightning strikes to radiation and – importantly, in the context of lift trucks – mechanically generated friction sparks and electric sparks among others.

“Hazardous area zones have to be identified and clearly marked, according to their classification, and **ATEX 94/9/EC**-compliant explosion-proof equipment, such as forklift trucks, diesel engines, access platforms, sweepers and cranes must either be selected or converted so that they are suitable for use in those areas,” Shirkie explained. “The classification of such equipment is directly matched to the risk in the zones in which they will be used.” [See Hazardous Area Classification chart]

Train and modify

Safe operation requires that forklift drivers should be properly trained for hazardous operations but the equipment they are using must be suitable for purpose. Making them compliant is a conversion activity in which Pyroban Group specialises. It has facilities in the UK, Netherlands, China and Singapore that convert forklift trucks and other materials handling equipment to ensure ATEX compliance.

“They must not have sources of ignition. Standard equipment has switches, hot surfaces and even static electricity from the seat,” he continued. “Pyroban goes right back to the bare chassis and assesses every element of the equipment, including brake linings, tyres, electrical and lighting systems, wiper motors and engine temperatures. They are rebuilt and certified as safe from causing explosions. Pyroban tries to achieve certification with minimum modification.”

Zone 1 areas can be serviced by **Category 2G** electric trucks still equipped with their original DC motors, which are completely enclosed within explosion-proof casings. **Category 3G** trucks, which operate in Zone 2 areas, are typically fitted with enclosures on DC motors which prevent gas penetrating for up to a minute. The Pyroban system also detects gas and shuts the truck down if necessary. AC motors are non-sparking in normal operation and use a different technology to the 60-second enclosure. →

1

1. A driver prepares a forklift truck that has been modified by Pyroban to EN1755: 2000 and American standard UL NEC500/505 and prepared to GB19854-2005 Chinese specification.

2. Cat® lift truck that has been prepared by Pyroban for ‘medium risk’ (Zone 2 operation) to Category 3G ATEX 94/9EC specification.



2

HAZARDOUS AREA CLASSIFICATION

APEX 94/9/EC CATEGORY 2G

An area in which an explosive mixture is likely to occur in normal operation.



APEX 94/9/EC CATEGORY 3G

An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist only for a short time.



APEX 94/9/EC CATEGORY 2D

An area in which an explosive mixture is likely to occur in normal operation.



APEX 94/9/EC CATEGORY 3D

An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist only for a short time.

Cool running

"Diesel trucks are modified so that the operating temperature of the engine is reduced below the required class level," said Shirkie. "A water-cooled jacket cools exhaust gases, and temperature probes are fitted in order to monitor engine, exhaust gas and manifold temperatures."

Pyroban's modifications also include spark arrestors and shutdown valves in order to inhibit ingestion of gases, which can cause overspeed running and potentially generate exhaust flame.

"Once a truck has been modified to meet the necessarily high safety standards, the right maintenance is essential to ensure it stays that way," he emphasised. "Any attention by untrained engineers is strongly discouraged as procedures that are not totally compliant can compromise the explosion-proofing in a matter of seconds."

Safe operation requires that forklift drivers should be properly trained for hazardous operations but the equipment they are using must be suitable for purpose.

Potentially explosive atmospheres are not the only challenges that forklift truck operators have to cope with. Heat and fine dust in aluminium smelters can clog up filters and accelerate wear in machine components. The heat has been known to melt rotating warning lights; a solution provided by Al Bahar, Cat Lift Trucks' dealer in the Middle East, was to provide an LED beacon with a different lens material.

And the electromagnetic fields around aluminium smelter pots are strong enough to wipe credit cards and interfere with electrical equipment; as a result, such operations use diesel trucks, even indoors, rather than battery-powered units. The diesel trucks are also less likely to ignite any fine bauxite powder that hangs in the air.

Modifications to ensure that air filters do not become clogged and that dust is kept out of the lubrication system are also part of the normal service. Even the tyres are special: they are solid pneumatic, providing the same shock-absorbing performance as normal units but without the risk of puncture.

At the other extreme, Cat Lift Trucks has been a sponsor of a project from the University of Utrecht which sent a solar-powered vehicle to Antarctica. Whatever the challenge, across a range of situations and temperatures, Cat Lift Trucks has the expertise to rise to it. ■

Article feedback is welcome: editor@eurekapub.eu

In search of automatic solutions



1. Vehicles are guided into their correct position by the Steril Comblok's structure. Note the lights for communication with drivers.

2. The Comblok automatically places a chock against one of the vehicle's rear wheels.

In eureka 23 we reminded readers of the risks faced by workers in loading docks and suggested simple measures to minimise the danger. Awareness and training, together with enforcement of best practice, should always be the first line of defence against accidents, but safety technology can help too.

Mark Nicholson reviews some of the technological 'safety nets' currently available.

Searching the internet using terms such as 'loading dock vehicle restraint systems', 'dock levellers' and 'dock shelters' reveals products from a wide range of manufacturers. A number of them have been chosen for this article to illustrate different approaches but many more could have been mentioned. There are systems and specifications to meet a variety of circumstances, needs and budgets, which the suppliers will be happy to explain and match to specific sites and operations.

Wheel locking

One of the most important safety challenges is to keep the vehicle stationary in the loading dock. It is surprisingly common for vehicles to be driven away before loading or unloading is finished. Even small movements, such as those produced by rocking of the trailer, can be enough to widen the gap between the vehicle and the dock, causing the loading platform to drop suddenly. Either way, the result is that forklift trucks, goods and staff may fall from a height. →





A good example of an automatic vehicle restraint system designed to solve this problem is the Stertil Combilok. Its structure guides the reversing vehicle into the correct position and then the Combilok mechanism is activated by pressing a button on a control panel in the loading bay. Moving to the rear wheel, which is detected using a sensor, the Combilok automatically inserts a chock against it. Interlock options include a link with the loading dock doors, so that opening is not possible until the Combilok has secured the vehicle.

Communication can often be difficult in loading dock operations, particularly when the drivers and warehouse personnel speak different languages. Systems like Combilok overcome this



3. Devices like Thorworld's Trailer Safety Support provide a simple but effective answer to trailer tipping.

4. Castell's Salvo system keeps the trailer brakes locked until it is safe for the vehicle to depart.

5. By moving the coupling plate, Don-Bur's Safe Coupling System allows safer access to trailer brake connectors.

6. These Thorworld dock houses, incorporating dock levellers, ensure a sheltered, controlled environment for loading activities.

7. The Salvo Chock is impossible to remove until loading is complete and the dock doors are shut.



by communicating with the use of lights, as everyone understands that red means stop and green means go.

Similar products include PowerLock 505 from Loading Systems and Stop Trucks from Expresso. Rite-Hite offers the Global Wheel-Lok, in which the reversing vehicle triggers a locking device which engages with the rear wheel. Again green and red lights tell the driver when it is safe or unsafe to drive away, and the vehicle is kept firmly in place until the warehouse staff unlock it.

Communication can often be difficult in loading dock operations, particularly when the drivers and warehouse personnel speak different languages.

Trailer brakes

An alternative approach is to make use of the vehicle trailer's brakes to prevent it from moving. If the brake line between the tractor unit and the trailer is uncoupled, fail-safe mechanical brakes are automatically applied. As long as the disconnected brake coupling is locked in some way, it is not possible for the trailer to be coupled to a vehicle and driven away.

Coupling and uncoupling can be an inconvenient process in which the driver has to climb into the space between the cab and trailer. This involves working at height, with the risk of falls, trips, slips and other hazards. Don-Bur has developed a pneumatically powered Safe Coupling System which moves the coupling plate to an easily reached position, with no climbing, when the driver needs to access it.

The Salvo system from Castell combines use of trailer braking with the extra security of its 'trapped key' technology. A device known as the 'SGL' ('Salvo Gladhand Lock') is applied to the trailer brake coupling to keep the brakes locked. A Salvo key trapped in the SGL is released only when this procedure has been correctly completed.

This key is inserted into a Salvo control panel at the warehouse. A green light inside the building tells staff that it is now safe to open the door and start loading or unloading, while the driver is shown a red light to indicate that the vehicle must not be moved. The key in the panel cannot be removed until the workers are finished and the door has been closed. A green light then signals the driver to remove the key from the panel, use it to release the SGL and depart. (In the UK, where a different type of brake coupling is used, a 'Salvo Susie' lock replaces the SGL.)

Chocks and stands

The main argument against relying on more traditional methods, such as using wheel chocks to stop movement and taking away the driver's keys to prevent driveaways, is that people sometimes forget or ignore the rules.

Castell's Salvo range offers a chock that forces drivers and warehouse staff to follow the right procedures. The Salvo Chock contains a trapped key which can only be released when the device has been properly clamped around the wheel. Transferring this key to a control switch at the loading bay allows the door to be opened. On completion of loading or unloading, the loading bay door must be closed before the key is released again. It is then used for removal of the chock.

One further safety aid which must be mentioned, although it is not as technologically sophisticated as those described elsewhere in this article, is the trailer stand or prop. When the tractor unit is removed from a trailer there is the danger of a see-saw effect, or even a tip-over, when fork lift trucks are driven into and out of it. To date, the author is not aware of any system that automatically puts a support in place but there are certainly products that reduce the effort needed. The Rite-Hite Trailer Stand and Thorworld Trailer Safety Support are just two examples from this market.

Dock levellers

Height differences between a vehicle's loading floor and the loading dock can produce dangerously steep gradients in the connecting platform. To minimise the slope and ensure the smoothest possible transition, dock levellers are recommended. This is an area in which there is a particularly large choice of products. Stertil, Loading Systems, Rite-Hite, Thorworld, Keeley, dockequipment.eu, Crawford and ASSA ABLOY are just some of the manufacturers.

To avoid slipping of forklift trucks, other materials handling equipment and personnel on wet surfaces, the loading dock should be weather-protected.

The most sophisticated dock levellers are electro-hydraulically operated, for high precision and efficiency with minimal effort. One choice to be made within these products is between swing lip (hinged) and extending lip (telescopic). Suppliers will advise on which type and model is best suited to the application. Factors to consider include the dimensions and load capacity required and the types of forklift truck and vehicle that will

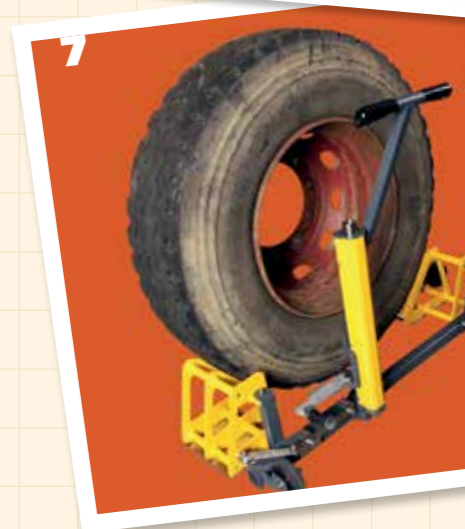
use them. These levelling systems can be interlocked with other dock systems, including door opening, vehicle restraint and warning lights, for maximum safety and productivity.

A controlled environment

To avoid slipping of forklift trucks, other materials handling equipment and personnel on wet surfaces, the loading dock should be weather-protected. This is another sector in which many manufacturers compete, offering a variety of ways to provide shelter as well as thermal insulation, hygiene and security. Stertil, Loading Systems, Rite-Hite, Thorworld, dockequipment.eu, Crawford and ASSA ABLOY are a few of the names you may come across in your searches.

Options include inflatable and cushion seals, as well as self-contained dock houses complete with sealing systems, secure doors and dock levellers. Considering that loading docks are seen as the most dangerous part of a warehouse, distribution centre or factory, it makes good sense to concentrate their activities and equipment into a small area where the environment and risks can be more easily controlled. ■

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THINK SAFETY

Although technological developments reduce the scope for human error, they should never be seen as an alternative to safety training, compliance with the law and encouragement of safe attitudes. You will find articles advising on health and safety throughout the previously published issues of **eureka**, as this is one of the magazine's key themes.

Visit the www.eurekapub.eu back catalogue to find out more.

Maintaining diesel fuel quality

Tackling chemical effects, water and microbes

Diesel is one of the materials handling industry's most basic requirements, but like other fuels it deteriorates with age. Chemical degradation, contamination with water and infestation with microbes can turn it into an unhealthy cocktail that damages your forklift trucks and your operation.

Mark Nicholson explores the problems and their solutions.



The symptoms of degraded diesel include:

- Poor engine performance
- Poor starting
- Higher fuel consumption
- Excessive black smoke
- Unpleasant smell from exhaust
- More frequent filter changes
- Filters clogged and slimy
- Fuel system components corroded or pitted
- Fuel with a dark and hazy appearance
- Sludge in tanks



At best, 'bad' diesel reduces the efficiency of your lift trucks' performance. At worst, it causes serious and expensive damage. If you think you can avoid this by buying only 'good' diesel, you are mistaken. The changes that turn good diesel bad usually take place in your own premises.

Suppliers of diesel in the EU and other economically developed regions are governed by rules on its quality, content and storage, so you can expect it to reach you in good condition. Always buying from a supplier with a good reputation lessens the risk of careless handling and storage in the supply chain from the refinery to your business. The differences between brands of diesel tend to be in the mix of additives used.

The problems

Even under the best conditions, chemical activity will eventually change the nature of stored diesel. The products of that chemistry include solid materials which form a slimy layer on surfaces and a sludge at the bottom of tanks. Water is bad news for engines on its own, but it also encourages microbial growth which speeds up the chemical degradation.

Let's look at each of those interacting factors in turn to see where they come from and what effect they have. As soon as diesel is exposed to air it reacts chemically. This starts off chain reactions that result in more and more undesirable molecules and solid breakdown products. As well as causing blockages, these substances are often corrosive. If you store diesel, they can become a problem within a few months – and even sooner if water and microbes increase their production.

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Diesel can become 'wet' through leaks in storage tanks and absorption from a moist atmosphere. Water in diesel is directly damaging to some engine components and it interferes with fuel combustion. It also reduces the fuel's lubricating effect, exposing engines to excess wear and damage. In a metal storage tank, water can lead to corrosion and further contamination. In addition, the presence of water helps microbes to thrive.

Diesel is an organic substance which can be used as food by a variety of bacteria, fungi and yeasts. Arriving via the air, in moisture or from a contaminated supply, these microbes can multiply hugely. Their acidic by-products, along with the slime created by their own biomass and by breakdown of the fuel, can be highly damaging. They form a layer or biofilm on surfaces, often collecting in pits and crevices where their corrosive effect becomes even more concentrated.

Slime and sludge produced by these factors blocks filters and fuel lines, while the acids affect engines, fuel systems, storage tanks and any other vulnerable surfaces coming into contact with them. Combustion efficiency decreases, engine life is shortened and bills for replacing components become more frequent. Once microbes have infected a forklift truck they are very difficult to eradicate.

The solutions

The first steps toward avoiding diesel quality problems are to buy it from a reputable supplier, as already mentioned, and to store it in suitable, well-maintained tanks. Regulations on storage of diesel vary a little between countries in Europe and mainly concern the potential environmental impact of leaks reaching water bodies and other natural habitats. For diesel users, avoiding the loss of expensive fuel should be a strong enough incentive to ensure vigilance against leakage.

Safety legislation is stricter for petrol than for diesel, but it must always be remembered that all fuels are flammable. Keeping storage tanks away from sources of heat is essential, and a cool environment also helps in maintaining the diesel's condition.

Some people may believe that the fuel filter in their forklift truck's engine will remove any contamination. This is unlikely. The fuel you put into the truck must be kept clean and in good condition within the storage tank. If diesel is stored at a low temperature, and certainly below 70 °F (21 °C), and care is taken to avoid contamination, it should last for a few months. To extend its life further, fuel stabilisers, biocides and other treatments may be needed.

A storage tank should be regularly checked for any defects that could let diesel leak out or water leak in, while openings should be water-tight and caps should be secured. The space between the fuel and the top of the tank is filled with air, which can be a source of moisture. Ideally that space should be kept to a minimum, allowing only enough for expansion of the fuel. This is another good reason for topping up frequently with fresh diesel from the supplier rather than storing large amounts.

A variety of fuel stabilisers can be bought for use if diesel has to be stored for relatively long periods. Regular, routine testing of stored fuel for water and microbial contamination is a sensible precaution. Simple-to-use test kits are available for this. The sooner these problems are detected, the easier and less costly they are to tackle.

Simple measures to reduce contamination risks include using a filter whenever moving fuel from one storage vessel to another.

If fuel is heavily contaminated by microbes, a large dose of biocide can be used to kill them. The dead bodies of the microbes, along with the solid material they have helped to create, need to be filtered out before the fuel is fit to use. Killing all of the microbes is difficult when they are living deep within slime and sludge, so biocide treatment will not work unless the storage tank is thoroughly cleaned.

Simple measures to reduce contamination risks include using a filter whenever moving fuel from one storage vessel to another, or into the tank of a forklift truck, and always doing this in a dry, dirt-free place. At the other end of the scale, for operations that really do require long-term storage of diesel in large quantities, there are specialists who can supply automatic systems for cleaning and removal of solids, water and microbes. Having invested heavily in your forklift trucks and your business, it makes absolute sense to protect them. ■

Article feedback is welcome: editor@eurekapub.eu

Who should you talk to?

The subject of diesel storage problems is a complex one and this article should be seen as just a brief introduction to it. Advice available in the marketplace varies substantially, so before deciding on which actions to take it would be best to speak to a number of different specialists including suppliers of fuel, testing services and treatments.

1. Store with care. The changes that turn good diesel bad usually take place in your own premises.

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