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ПАТ «УКРЗАЛІЗНИЦЯ»**

**Тези доповідей
міжнародної науково-технічної конференції**

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Збірник містить тези доповідей науковців вищих навчальних закладів України та інших країн, підприємств транспортної та будівельної галузі за такими секціями: технології виготовлення та відновлення виробів транспортного призначення; проектування, виробництво та сервіс засобів транспорту; транспортні технології та логістика; проблеми безпеки на транспорті, в промисловості та інфраструктурі; захист довкілля, екологічна безпека та ресурсозберігаючі технології; забезпечення конкурентоспроможності підприємств транспорту і промисловості; інтеграційні процеси фінансово-економічного розвитку транспортної галузі.

ЗМІСТ

СЕКЦІЯ

«ТЕХНОЛОГІЇ ВИГОТОВЛЕННЯ ТА ВІДНОВЛЕННЯ ВИРОБІВ ТРАНСПОРТНОГО ПРИЗНАЧЕННЯ»

<i>М. В. Загирняк, В. В. Драгобецкий, Е. А. Наумова, С. В. Шлык, А. А. Шаповал</i> МЕТОД ОПРЕДЕЛЕНИЯ ЭКСПЛУАТАЦИОННОЙ ДОЛГОВЕЧНОСТИ ПЛАСТИЧЕСКИ ДЕФОРМИРУЕМЫХ ЛИСТОВЫХ ДЕТАЛЕЙ	29
<i>О. Г. Чернета, В. І. Кубіч, Р. Г. Волощук</i> ДОСЛІДЖЕННЯ МІКРОТВЕРДОСТІ ДЕТАЛЕЙ ІЗ СТАЛІ 45 ДО І ПІСЛЯ ЛАЗЕРНОГО БОРУВАННЯ	31
<i>О. Г. Чернета, В. І. Кубіч, Р. Г. Волощук</i> ПОВЕРХНЕВИЙ ШАР ДЕТАЛЕЙ ІЗ СТАЛІ 45 ПІСЛЯ БОРУВАННЯ З НАСТУПНОЮ ЛАЗЕРНОЮ ОБРОБКОЮ	33
<i>С. В. Воронін, Б. С. Асадов</i> МАТЕМАТИЧНА МОДЕЛЬ ДЛЯ РОЗРАХУНКУ ОСНОВНИХ ПАРАМЕТРІВ ЗМАЩУВАЧІВ АЕРОЗОЛЬНОГО ТИПУ	35
<i>А. О. Задорожний, А. П. Ковревський, Ю. В. Човнюк, М. П. Ремарчук</i> ОСОБЛИВОСТІ ТЕЧІЇ РІДИН ЗМІННОЇ В'ЯЗКОСТІ ПО ТРУБОПРОВОДУ РІЗНОЇ ФОРМИ ПОПЕРЕЧНОГО ПЕРЕТИНУ	37
<i>О. В. Устенко, С. С. Тимофеев, Н. Р. Огульчанська, М. В. Грибанов, Д. Г. Воскобойников</i> АНАЛІЗ РУЙНУВАННЯ ГОЛОВОК РЕЙОК	39
<i>О. А. Охріменко, А. В. Мініцький, М. О. Сисоєв, Н. В. Мініцька</i> ПОВЕРХНЕВЕ ЗМІЦНЕННЯ ПОРОШКОВИХ ЗАЛІЗОВУГЛЕЦЕВИХ СПЛАВІВ	40
<i>В. О. Стефанов, Д. В. Онопрейчук, В. В. Пащенко, Г. О. Радіонов</i> ОБҐРУНТУВАННЯ РАЦІОНАЛЬНОЇ КОНЦЕНТРАЦІЇ ПРОТИЗНОШУВАЛЬНОЇ ПРИСАДКИ В ГІДРАВЛІЧНИХ ОЛИВАХ ВИРОБІВ ТРАНСПОРТНОГО ПРИЗНАЧЕННЯ	42

Л. Ф. Коженювскі

ЗВ'ЯЗОК НАУК ПРО БЕЗПЕКУ З ПРИРОДНИМИ НАУКАМИ 301

А. С. Беликов, А. В. Пилипенко, Н. Н. Налісько, В. А. Шаломов

**РАДІАЦІОННА ОБСТАНОВКА НА УЧАСТКЕ
АВТОДОРОГИ Н-08 ДНЕПР-КАМЕНСЬКЕ ПРОХОДЯЩЕЙ
ВБЛИЗИ ХВОСТОХРАНИЛИЩ УРАНОВОГО ПРОИЗВОДСТВА
ПО «ПХЗ»** 303

К. В. Данова, М. В. Хворост

**ЗАБЕЗПЕЧЕННЯ БЕЗПЕКИ ПРАЦІ ОСІБ ІЗ ІНВАЛІДНІСТЮ
В УМОВАХ ТРАНСПОРТНОГО ПІДПРИЄМСТВА** 305

М. В. Хворост, В. В. Малишева

**ДОСЛІДЖЕННЯ ЕФЕКТИВНОСТІ ЗАСТОСУВАННЯ
ЗАХИСНИХ ЕКРАНІВ СКЛАДНОЇ КОНСТРУКЦІЇ У
БОРОТБІ ІЗ АКУСТИЧНИМ ЗАБРУДНЕННЯМ
ЗАЛІЗНИЧНИХ КОЛІЙ** 307

Д. І. Буліч, С. Ю. Сапронова, В. П. Ткаченко

**ВПЛИВ НЕВИЯВЛЕНИХ ДЕФЕКТІВ ВАНТАЖНИХ ВАГОНІВ
НА БЕЗПЕКУ РУХУ** 309

Ю. Л. Фещук, С. В. Поздєєв, В. В. Ніженик

**АДЕКВАТНІСТЬ ВИМІРЮВАННЯ У ФРАГМЕНТАХ
ДЕРЕВ'ЯНИХ КОЛОН ПІД ЧАС ВОГНЕВИХ ВИПРОБУВАНЬ** 311

СЕКЦІЯ

«ЗАХИСТ ДОВКІЛЛЯ, ЕКОЛОГІЧНА БЕЗПЕКА, РЕСУРСОЗБЕРІГАЮЧІ ТЕХНОЛОГІЇ»

Martijn Beerthuisen

WAYS TO IMPROVE THE EFFICIENCY OF DIESEL FUEL USE 314

O. Sushchenko, I. Trunina, O. Prokopishyna, N. Kozubova

**ECO-FRIENDLY BEHAVIOR OF LOCAL POPULATION,
TOURISTS AND COMPANIES AS A FACTOR OF
SUSTAINABLE TOURISM DEVELOPMENT** 318

А. А. Алексахин, А. В. Панчук, Л. А. Пархоменко, А. В. Беловол

**ТЕПЛООТДАЧА В КАНАЛАХ СИСТЕМЫ ОХЛАЖДЕНИЯ
ТЯГОВЫХ ЭЛЕКТРОДВИГАТЕЛЕЙ** 321

СЕКЦІЯ «ЗАХИСТ ДОВКІЛЛЯ, ЕКОЛОГІЧНА БЕЗПЕКА, РЕСУРСОЗБЕРІГАЮЧІ ТЕХНОЛОГІЇ»

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WAYS TO IMPROVE THE EFFICIENCY OF DIESEL FUEL USE

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Over the past years, there have been a lot of discussions about fuel enhancers and whether these work or not. In this article, we will explain some of the problems and solutions.

In the world of engines and fuel, there are 3 mayor players:

1. the engine manufacturer,
2. the fuel producer, and
3. the engineer or owner of the engine.

Fact is that the first 2 players have no interest in aftermarket modifications of the engine and the fuel, simply because they have different interests. They don't want you to extend the life of the engine or improve performance of the fuel, as their only interest is you buying a new engine or more fuel from them. This causes some discussion in the technicians' world: can you modify the engine and fuel and, if you do so, does this affect your warranty or the engine's life expectancy.

The engine manufacturer builds an engine to specific classifications and they have only 1 objective: you buying their engine and their spare parts. As soon as you buy the engine, they lose interest in you as an owner and the only thing they want, is to sell you a new engine as quick as possible. Engine manufacturers always have new developments and they wait with releasing the new design or modification as long as possible. They've invested in this model and they want to sell as many of them as they can.

E.g.: DAF is an engine manufacturer and they spend a lot of money on new developments, but they won't release these until they really have to, under pressure of the market or by regulations from government. DAF developed the Euro6 engine almost 15+ years ago, but stored this new engine and only released it a few years ago. All engine manufacturers do so and that's the way the market works.

Engines are always made in a such way that they can be used all over the world. This means the engine has a setting that is considered safe by the manufacturer but in reality, by applying some small modifications, the engine can be a lot more powerful and more economical, if you know what to do.

Fuel manufacturers make fuel for the market, according to the specific fuel regulations and within the limitations of the spectrum of quality allowed. This means that for every type of fuel, you have a whole range of qualities within the spectrum. Fuel producers want you to use their fuel and they design it in such a way that you

would buy it. Either on price or on quality, they add additives to the fuel within the rules and limitations and they do that in such a way that they make the most profit on every liter you buy. This automatically means that the fuel you buy is not necessarily the best modified fuel you can get. You as a technician or engine owner have to decide for yourself if you simply accept what you can get, or if you want to make your engine more cost effective by adding more additives to the fuel.

Every type of diesel fuel already has a series of additives or dopes added to the fuel. Basic diesel fuel is made from crude oil and is not really usable. The basic diesel fuel has a low combustion rate (low citane/low caloric value), has sulfur in it and contains moisture or water particles and other parts, that may cause pollution or engine failure. In order to comply with the rules and regulations in the world, the fuel manufacturers add several types of additives or dopes to the fuel to adjust to the rules and make the diesel fuel usable. The additives they add have specific characteristics, being citane enhancers, lubrication enhancers or others. If you buy diesel fuel at the fuel station, you buy a product that complies with the rules on that specific type of fuel (like EN590, regular diesel fuel for diesel engines) but you never know the exact contents. Cheap diesel fuel is often bought at the fuel station, but this type of low price diesel fuel only has the bare minimum of additives to the fuel, as adding these additives makes the fuel more expensive. You as the buyer can modify the cheap fuel to a premium fuel, simply by adding the additives that are available. These additives come in the form of fuel enhancers or fuel additives.

In the world of fuel enhancers, you have 2 types available, the chemical enhancer, and the “natural” enhancer. The chemical enhancer uses chemical compounds that mimic some of the workings of the diesel’s own components and they simply pump up the needed reaction. These chemical solutions often have but 1 task, either enhancing the caloric value of the fuel, or dealing with water/bacteria. As the compound of the chemical enhancer is complex, often a chemical enhancer only does 1 specific thing. Mixing chemicals together to achieve a multi solution is difficult and not cost-effective. This is one of the reasons chemical enhancers are often marketed as a single-solution product. The products inside these chemical enhancers are normally not found in raw diesel and are considered foreign to the fuel. The “natural” enhancers are made from crude oil derivatives such as Kerosene and oil. These “natural” enhancers can have more than 1 task to do. Boosting the caloric value of the fuel, lubrication for the engine and dealing with water and bacteria. The “natural” enhancers are often the all-in-one solution. Both types of enhancers are allowed in the fuel and do have effect. You as an owner will have to decide which one you prefer, more than often based on pricing and projected performance and results.

Natural enhancers are made from dopes or additives that are native to fuel. They come from refining crude oil and normal regular diesel fuel already have several of them added at the fuel refinery, so the fuel complies to the law. By adding natural fuel enhancers, you only add a little bit more of the additives that are in the fuel already and by doing so, you can alter basic fuel in a more premium type of fuel that is also available at the fuel station, but you can do that at a much lower cost, by

using fuel enhancers. The additives in natural enhancers are mixed in such a way, that when added to any type of fuel, you never cross the line on maximum levels of each additive or dope. This is why you always want a fuel enhancer that has the correct certifications. If an enhancer doesn't have these certifications or won't show them, be very cautious, as adding the enhancer might raise some levels to above maximum rules for diesel fuel. If you do that, you could damage the engine or get a high penalty from your government, as the fuel you use is not "on spec" and therefore illegal. Always check if a product has the right certifications!

Fuel enhancers are bound by strict rules. Most important rule is that by adding the fuel enhancer to the fuel, you may never exceed the maximum for each additive that is allowed in the diesel fuel. Diesel fuel enhancers must be usable on basic cheap diesel, but also on high end premium diesel. The enhancer is mixed in such a way that you will never cross the line.

A good example of this is Citane level. Citane levels in EN590 (basic diesel fuel for cars, trucks and trains) has a citane level between 32 and 58. 32 citane is low grade diesel fuel, cheap to buy but not very effective and causes a lot of pollution. 58 is a high grade diesel fuel, better known as premium diesel fuel. This 58 citane level will get you a better fuel consumption and more results per liter.

Adding additives to either 32 or to 58 citane diesel may never result in crossing the maximum line for citane. Well-certified diesel enhancers have been tested for this and have the right document to show that. If you cross that line, you will create a diesel fuel that behaves as a benzene and that will cause damage to the engine, as the engine is designed for diesel and not for benzene.

In the fuel additive world, you have 4 basic issues to work on:

1. Caloric value (bigger bang for your money means more power)
2. Emission (lowering the emission to comply with legislation)
3. Water (water and moisture are native to diesel fuel and are always there)
4. Bacteria

By adding products like kerosene to the diesel fuel, you make the fuel more powerful. Kerosene has a higher caloric value and will make the diesel more aggressive. The engine will react quicker and combustion will be a lot better, as diesel fuel in basis is not very flammable, whereas kerosene is. Regular pump diesel already has a small amount of this product inside, just enough to deliver the minimum wanted results. One problem you get with adding kerosene to the mix is that the temperature of the engine will rise due to better combustion. This eventually will cause a raise in NOx in the exhaust, but that can be countered by using Ad Blue in the exhaust system, or simply by lowering the overall engine temperature. The lowering of the engine temperature can be done by forced cooling or by adding Nano-technology to the engine oil. Nano-technology reduces friction inside the engine on the moving parts. As friction is the main cause of heat, Nano-technology can be a great help.

Mercedes F1 uses a specific type of lubrication oil in their fuel. We have all seen the puff of smoke when the engine starts up or makes a fast acceleration. As the performance for the engine has to be high, temperatures will rise and friction can be a

major contributor in problems. By adding this lubrication oil to the fuel, you help reduce friction on the pistons. Chemical additives can't do that, but most "natural" based enhancer do have oil added to the mix.

Water is always present in diesel fuel. Small particles of water float inside the diesel fuel and this can be a good thing or a really bad thing. Water or moisture is a natural component of diesel fuel, but water also has one nasty habit: water always attracts more water and as the atmosphere contains moisture or water, you can get an accumulation of water inside your fuel, simply because there is air in your fuel tank. On top of the water or moisture in the air, heat is also a big contributor to the problem. Humidity is caused by an overload of moisture and water in the air and when the fuel sits in the tank for a longer period of time, the build-up of water can be enormous.

For example: A few years ago, the Dutch military were posted in Mali, in the middle of the Sahara desert. They operated Apache helicopters for peacekeeping in the area and as the rules require, the fuel bunker was above ground in the full sun. One of their helicopters crashed in the desert and the pilot was killed. After an investigation into the cause of the crash, the outcome was for a lot of people surprising: water.... As the fuel tank was placed in the open air, in the blazing sun, the humidity inside the fuel tank was high and as fuel contains water, the build-up of water had escaped notice. Investigation revealed that the fuel was so polluted with water, that the engine in effect tried to run on pure water, which of course did not work. Steps were taken, following this accident and the fuel used was modified with water-reducing enhancers.

Water is not always bad for fuel. A small amount of it will actually help the combustion as such, just make sure it's never too much. When water is brought into the combustion chamber, the compression will cause it to heat up and expand. By doing so, the compression inside the combustion chamber will rise, which has a positive effect on the performance of the engine. In the ideal situation, water or moisture is broken up into small particles and kept from binding to other water particles and afloat inside the fuel. Fuel enhancers can have a specific designed additive in the mix that breaks moisture and water into small particles. After breaking it into small pieces, the water or moisture particles need to be sealed. By sealing the particles, you prevent the water particles from bonding with other particles and therefore stop the build-up of water in the fuel. This is a very effective way of preserving your fuel, as water is the main contributor for "aging" of the fuel.

This "aging" of fuel is a big problem. As time goes by, water will build up in the fuel, to a level where fuel is no longer usable. Inside the water is another problem: bacteria. Bacteria cause sludge in the fuel and this sludge will block your pumps, filters and injectors, as it is a solid substance with a much higher density. As fuel enhancers often have water-capsuling additives inside, water will be closed off from air and by doing so, the growth of bacteria is stopped. This process, breaking up water and preventing the growth of bacteria will extend the life of fuel and prevents damage to the engine as a whole.

Opposite to water as a problem is something called water emulsification. Simply put, adding water to the fuel, but in such a way that it floats in the water in extremely small particles. Several scientists in the world are experimenting with this topic. Their goal is to make a machine that can emulsify water into diesel to the desired level, so as to enhance the combustion. Petronas University in Malaysia has a whole division dedicated to this subject. By emulsifying water into diesel, it has been proven that diesel becomes more powerful, and fuel reductions have been registered using this development. Big problem is that water has the tendency of not wanting to mix with fuel, as the density is different. A Dutch scientist, Mr. Wilko Pels has developed a working machine to accomplish this process. His development is called OCRI and consists of a machine that can inject water molecules under high pressure into the fuel. Important development in his invention is that he managed to keep the water afloat and emulsified in the fuel for a long period of time, whereas other developments only manage to keep the water in particle setting for a short period of time. Mr. Pels is now experimenting with adding fuel additives to the fuel/water mixture, as he wants to prevent the free-floating molecules to bind with each other and keep the bacteria inside the water molecules from growing. If he succeeds in this development, he will have the first fully operational unit in the world. This development of water emulsification causes a fuel reduction on trains and other engines of 2 till 5%. The system will be tested in Ukraine on diesel trains by adding the emulsification machine on the back of the diesel train during field tests. Alongside the field testing, a laboratory test will be conducted at Kharkov Railroad University on the new engine testing facility.

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ECO-FRIENDLY BEHAVIOR OF LOCAL POPULATION, TOURISTS AND COMPANIES AS A FACTOR OF SUSTAINABLE TOURISM DEVELOPMENT

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Environmental protection today are not only the key to the implementation of sustainable development of society, but also the essential factor survival of manhood. Deforestation, destruction of the biosphere, exploitation of natural resources, harmful emissions, waste products and refuse of consumption disrupt the ecological and energy balance of the planet and lead to global climate change on the Earth, which every year becomes more tangible. The UN [1], published data that should draw the attention of the public and state bodies to the solution of problems of environmental protection.