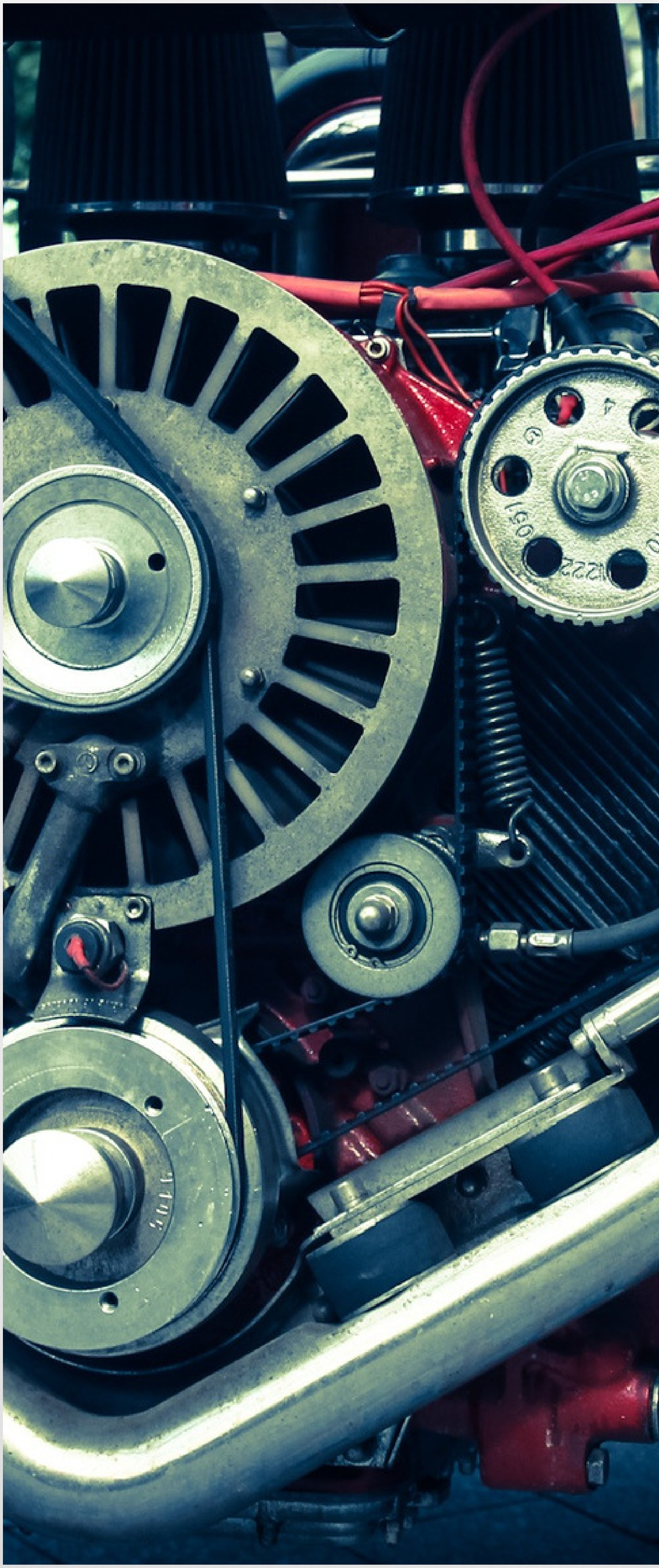

FUELS TEAM

HARMFUL CHEMICALS IN PETROL
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IMPACT OF N-METHYLANILINE (NMA), AROMATIC AMINES AND ANILINE DERIVATIVES ON GASOLINE ENGINES

2017

HARMFUL CHEMICALS IN PETROL

- N-methylaniline (NMA) as well as chemically related derivatives such as aromatic amines and aniline derivatives are known for their octane boosting characteristic in gasoline petrol. However, beside this positive feature, engine damaging properties are attributed to these kind of substances.
- To gather and identify performance characteristics, material compatibility as well as toxicity of NMA and chemically related derivatives as antiknock agent a literature survey was conducted by Univativ. Thereby, particular attention was paid to harmful effects on gasoline engines. In the following, the most interesting findings of the literature survey are summarized.

Octane enhancing properties

Investigations on various aniline-type compounds indicate their potential as octane-boosting agents. Determined research octane numbers (motor octane numbers) for pure substances range from 95 (84) to 370 (320) with N,N-dimethylaniline resulting in the lowest and 3,4-xylidine in the highest octane number whereas NMA shows a RON (MON) of 280 (250).[1,2,3] When used as additive for different petrol types, 1% of NMA is able to lead to a RON (MON) increase of up to 3.7 (5.6) in case of primary distillate. Interestingly, the research sector tends to study the effect of combining multiple antiknock additives in one formulation on octane enhancement. Blending primary distillate with 1% of a mixture of NMA and a manganese compound the RON (MON) can be increased by 7.3 (11.2). When using 1.9% of a mixture of NMA and MTBE, the RON (MON) improves by 5.8 (7.9) whereas 10% of MTBE in primary distillate is not sufficient to obtain the same octane number enhancement. [4] The direct comparison of NMA with MTBE reveals that 10% of MTBE are required to achieve the same octane improvement of 6 when 1.3% of NMA are applied in the same type of gasoline.[5]

Technical drawbacks of NMA as antiknock agent

While there is no truly comprehensive publication on harmful effects of NMA, a number of technical drawbacks of NMA can be derived from literature:

- Tendency for phase separation at low temperature attributed to all aniline derivatives 1,5
- Promoted soot formation in cylinders, injection and exhaust valves leading to mechanical abrasion when applied in concentrations above 1.5% [6]
- Formation of gum deposits in fuel system and combustion chamber when added at concentrations above 5%
- Increased swelling of sealing rigs
- Lowered induction period
- Enhanced copper strip corrosion

The latter disadvantages are all associated to blends with NMA significantly exceeding a typical concentration of 1.3%. However, no traceable sources and references as well as descriptions of investigation methods are available. Thus, this information needs to be verified.

Exhaust fumes of fuel that was blended with a maximum amount of 1.3% NMA does not measurably deviate from typical emissions and are within the limits and regulations for gasoline. In case of higher NMA concentrations, an increasing amount of nitrous oxides in the exhaust gas is observed. [7]

3. Toxicity of NMA

Numerous investigations substantiate the toxicity of NMA and related compounds orally, on the skin [8], as vapor in air [9] as well as for a broad range of aquatic species10. Thereby, ortho-substituted anilines seem to be less toxic than unsubstituted ones. [10]

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ABOUT FUEL ETHERS

FUEL ETHERS, INCLUDING MTBE, (BIO)-ETBE, TAME AND TAEE, ARE KEY COMPONENTS FOR THE PRODUCTION OF HIGH OCTANE FUELS. THEY ARE THE CLEAN REPLACEMENT FOR COMPOUNDS THAT POSE A PROVEN RISK TO HEALTH AND THE ENVIRONMENT. WHETHER MANUFACTURED FROM TRADITIONAL HYDROCARBONS OR RENEWABLE BIOMASS, FUEL ETHERS ARE MORE ENERGY DENSE THAN ALCOHOLS. THEY THEREFORE INCREASE PETROL’S PERFORMANCE, WHILE REDUCING THE EMISSIONS OF AIR POLLUTANTS AND CO2 ACROSS THEIR LIFE-CYCLE.