Chapter 1 : Air Pollution Emissions Overview | Air Quality Planning & Standards | US EPA

Emission Control Science and Technology is a forum for publication of the latest research on control of emissions from mobile and stationary sources. Papers are also welcome on various aspects of development and technology. The investigation may be experimental, theoretical, or computational.

Scatter plots of CO emissions from model-year federal cars. Adapted with permission from General Motors Corp. Emissions Regulations In the s, motor vehicles were identified as one of the primary sources of air pollutants in urban areas. Emission standards for passenger cars were first imposed in California in These were followed by U. Recognition of the motor vehicle as a major source of pollutants has spread to other countries, of which many have imposed diverse standards and test procedures reflecting various degrees of stringency. The differences have come about because of different regulatory philosophies and air quality goals, in combination with concerns about the conflicting goal of improved fuel efficiency Barnes and Donohue Emission Test Procedures Passenger Cars. Emissions come principally from three automotive sources: To give the standard maximum allowable level of emission in grams per mile operational meaning, two major aspects must be defined: Driving cycles are discussed below and sampling methods will be covered in a later section. Regulations require exhaust emission measurements during the operation of the vehicle or engine on a dynamometer during a driving cycle that simulates vehicle road operation. The approach to driving cycles by various regulatory authorities represent two basic philosophies. According to the first, the driving cycle is made up of a series of repetitions of a composite of various vehicle operating conditions representative of typical driving modes. The European Economic Community and Japanese cycles reflect this philosophy. According to the second, the composite of driving modes is an actual simulation of a road route. Two such cycles are run: Many of the light-duty trucks intended primarily for the carrying of goods are also capable of use as passenger vehicles. The gross vehicle weight for light-duty trucks in the United States is less than 8, Ib; trucks heavier than 8, Ib are classified as heavy-duty vehicles. The driving-cycle philosophies for the light commercial vehicles follow those for passenger cars. For heavy commercial vehicles, engine dynamometers are used, not chassis dynamometers; that is, the engine rather than the vehicle is certified. The new effective U. The use of this cycle replaces the mode steady-state cycle in use since in California and since nationally U. Environmental Protection Agency Emission Standards United States. Emissions standards and test procedures in the United States have changed significantly since the first automobile emission standards were imposed in California in see table 1 General Motors Corp. Light-duty truck standards are somewhat higher than the car standards because of the differences in weight. The European Economic Community, an inter-Europe regulatory body, has announced future model standards for passenger cars based on three engine size displacement categories. Standards for medium cars. The standards include diesels; however, large diesel cars are only required to meet medium-car levels. Catalyst forcing standards currently in effect for passenger cars are 0. These standards are generally considered to be equivalent to current U. California levels Ford Motor Co. Fuel Economy Standards There have been passenger car and light-truck fuel economy standards since and , respectively. The manufacturers are required to conduct passenger car fuel economy tests according to the U. A combined fuel economy number based on these two tests is published by the EPA and the U. Department of Energy and used by manufacturers in their sales literature. Car standards started at 18 miles per gallon mpg in , went to Department of Transportation for â€” Vehicle and Emission Control System Technology The technology used for emission control in cars changed rapidly in the s as the automotive industry spent considerable research and development funds to meet the stringent emission standards originally set by the and Clean Air Act Amendments. This technology is now being optimized to reduce the product cost associated with emission controls while improving the in-use durability of the emission control systems. Heavy-duty gasoline-powered vehicles have used this technology as allowable emissions have progressively decreased. Control technology is being developed to meet proposed standards and anticipated changes in fuels. Proposed , , and particulate standards require new control systems for heavy-duty diesels. For the United States to become less dependent on imported petroleum fuels, there is interest in using methanol in passenger cars and diesel-fueled buses. There are continued efforts to develop stratified-charge engines for passenger cars because of their potential for better fuel economy at equivalent emissions. There is also a demand for development of direct-injection diesels that give 15 percent better fuel economy than prechamber or swirl-chamber engines with equivalent or better emissions. An additional demand exists for an adiabatic diesel engine more precisely, a low-heat-rejection engine that would have improved fuel economy and lower emissions with a simpler cooling system, particularly for vehicles in the heavy-duty class. Spark-Ignition Gasoline-Powered Vehicles During the past 15 years, emissions have been significantly lowered by improved design of the engine and fuel system while still achieving the high fuel economy demanded by the federal standards and the consumer market. This scheduling is referred to as the engine calibration. The period after has seen better optimization of systems and removing of components to reduce costs, but nevertheless, catalysts are still necessary. The time required for this is a function of catalyst design and position but can be from 20 to sec. The HC emitted during this period can be one-fourth to three-fourths of the allowable limit Hilliard and Springer The amount of NO x emitted during the cold start is only about 10 percent of the allowable limit. The time period from to saw increased fuel economy and improved emission control through exploitation of the high HC and CO removal efficiency of the oxidizing catalytic converter, so that the engine calibration could be optimized for efficiency. Progress was made by decreasing the cold-start engine-out HC and CO emissions, by achieving faster converter light-off, by reducing heat loss from the exhaust system, and by reducing the deterioration of catalyst performance with cumulative driving distance Amann Two additional catalytic approaches have gained widespread application along with the microprocessor control system, to provide the necessary control: Three-way catalysts are capable, within a narrow range of exhaust stoichiometry, of simultaneously decreasing NO x , HC, and CO, as shown in figure 7. An oxygen sensor is used in the exhaust in conjunction with a microprocessor to make this technology feasible. Conversion efficiency characteristics of a three-way catalyst. Adapted with permission from Amann In a dual catalyst, two catalysts are used in seriesâ€”a three-way catalyst followed by an oxidizing catalyst. Air is injected into the exhaust gas between the two catalysts to provide the oxygen necessary for the oxidizing catalyst to operate efficiently. During the cold-start portion of the FTP cycle, the air supply to the oxidizing catalyst can be diverted to the exhaust ports to add oxygen to the combustion products of the rich start-up mixture for faster catalyst light-off and to achieve higher HC and CO control efficiencies in the three-way catalyst. The dual-bed converter is more complex than the single-bed three-way catalyst, because it requires an extensive air management system. The schematic of a typical system is shown in figure 8 Amann The key element in the closed-loop system is the oxygen sensor inserted in the exhaust pipe ahead of the catalyst. It measures exhaust oxygen concentration and signals an electronic controller to adjust fuel rate continuously so that the mixture is maintained at the stoichiometric ratio. The oxygen sensor inserted in the exhaust pipe ahead of the catalyst measures oxygen concentration and signals the electronic controller to adjust fuel rate continuously. Adapted with permission from Amann more Since the number of engines with some type of fuel injection has grown drastically, but carburetors are still used on many engines. No particular trend in emission systems is evident except for the use of heated oxygen sensors to initiate closed-loop operation faster and more predictably and to maintain it during long idling periods. The heated sensors also deteriorate less with extended mileage Way Most cars use closed-loop control with a three-way catalyst; many also have an oxidation catalyst that is a dual catalyst and one of three air supply systems pulse air, air pump, or programmed pump. An important engine emission control system under development is the lean combustion system. This system uses a closed-loop microprocessor in conjunction with lean mixture sensor and an oxidation catalyst. This alternate emission control approach achieves good fuel economy potential 10â€”15 percent improvement and also meets the emission standards by operating beyond In this lean operating region, the engine needs a different sensor design to provide feedback, and also a highly turbulent fast-burn combustion system so that slow flame speed and misfires do not cause emissions and driveability problems. Toyota has developed and marketed such a system in Japan but not yet in the United States Kimbara et al. It may be possible to introduce this type of system into the U. The other important technological limit might be that lean burn could be restricted to cars under 2,â€” 3, lb because NO x generally increases with vehicle weight. Particulate Control There has been a major research and development effort during the past seven years to develop aftertreatment devices for diesel passenger cars to meet the federal 0. California has a 0. A number of prototype systems have been built and field tested to meet the 0. Mercedes-Benz Abtoff et al. The system meets and is certified to the California standards and has been sold in the 11 western states. Volkswagen has developed a prototype system that uses a Corning ceramic particulate filter in conjunction with Lubrizol manganese Mn additive. The additive consists of nonstoichiometric Mn fatty acid salts dissolved in naphtha, which is metered from a separate fuel-additive storage tank on the vehicle lifetime filling and mixed with the fuel Wiedemann and Neumann Emissions of Mn oxide of all valence states, as well as MnSO4, may occur. Data suggest that most of the Mn residue is in the form of sulfate. General Motors has also tested a system, shown in figure 9 , with on-board tank-blending, additive dispensing, and ceramic fiber trap Simon and Stark This system uses pressure and engine speed to provide a measure of particulate loading for triggering the glow plug igniters for regeneration. Simon and Stark investigated three different additives: Their tests showed that vehicles equipped with properly tuned 4. Equipped with particulate traps, however, the vehicles would probably meet the federal standards and might, with further engine tailoring, be able to meet the California standards on a production basis. Diesel particulate trapping system utilizing a ceramic fiber trap, a fuel additive, glow plug igniters, and exhaust backpressure regeneration controls. Diesel-Powered Heavy-Duty Vehicles Diesel-powered heavy-duty vehicles use direct-injection turbocharged engines of two-cycle as well as four-cycle design. Diesel engines are designed for a commercial market and hence durability, reliability, and fuel economy drive their development. The approaches enforced to date to meet the standards for particulates, HCs, and NO x have involved improved turbochargers, intercooling, improved fuel systems and nozzles, and electronic fuel injection control.

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Chapter 2 : Automotive Emissions - Air Pollution, the Automobile, and Public Health - NCBI Bookshelf

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By-products of the operation of the gasoline engine include carbon monoxide, oxides of nitrogen, and hydrocarbons unburned fuel compounds , each of which is a pollutant. To control the air pollution resulting from these emissions, governments establish quality standards and perform inspections to ensureâ€¦ In the crankcaseâ€”the portion of the engine block below the cylinders where the crankshaft is locatedâ€”leaked combustion gases are combined with ventilating air and returned to the intake manifold for reburning in the combustion chamber. The device that performs this function is known as the positive crankcase ventilation valve, or PCV valve. To control exhaust emissions, which are responsible for two-thirds of the total engine pollutants, two types of systems are used: In EGR a certain portion of exhaust gases are directed back to the cylinder head, where they are combined with the fuel-air mixture and enter the combustion chamber. The recirculated exhaust gases serve to lower the temperature of combustion, a condition that favours lower production of nitrogen oxides as combustion products though at some loss of engine efficiency. In a typical air-injection system, an engine-driven pump injects air into the exhaust manifold, where the air combines with unburned hydrocarbons and carbon monoxide at a high temperature and, in effect, continues the combustion process. In this way a large percentage of the pollutants that were formerly discharged through the exhaust system are burned though with no additional generation of power. Another area for additional combustion is the catalytic converter , consisting of an insulated chamber containing ceramic pellets or a ceramic honeycomb structure coated with a thin layer of metals such as platinum and palladium. As the exhaust gases are passed through the packed beads or the honeycomb, the metals act as catalysts to induce the hydrocarbons, carbon monoxide, and nitrogen oxides in the exhaust to convert to water vapour, carbon dioxide , and nitrogen. These systems are not completely effective: Preheating the catalytic converter is a possible solution to this problem; the high-voltage batteries in hybrid cars, for example, can provide enough power to heat up the converter very quickly. In the past, gasoline fumes evaporating from the fuel tank and carburetor were vented directly into the atmosphere. Today those emissions are greatly reduced by sealed fuel-tank caps and the so-called evaporative control system , the heart of which is a canister of activated charcoal capable of holding up to 35 percent of its own weight in fuel vapour. In operation, fuel-tank vapours flow from the sealed fuel tank to a vapour separator, which returns raw fuel to the tank and channels fuel vapour through a purge valve to the canister. The canister acts as a storehouse; when the engine is running, the vapours are drawn by the resultant vacuum from the canister, through a filter, and into the combustion chamber, where they are burned. Improvements in combustion efficiency are effected by computerized control over the whole process of combustion. This control ensures the most efficient operation of the systems described above. In addition, computer-controlled fuel-injection systems ensure more precise air-fuel mixtures, creating greater efficiency in combustion and lower generation of pollutants. Learn More in these related Britannica articles:

Chapter 3 : Alternative Energy for Transportation | Issues in Science and Technology

The History and Development of Emissions Control Technology Haren Gandhi Contributions to the Development and Implementation of Catalytic Emissions Control Systems.

Share Setting Emissions Standards Based on Technology Performance The Clean Air Act requires emissions standards for pollution sources such as motor vehicles, power plants and industrial facilities. Most of these provisions call for setting standards based on the emissions performance and cost of technologies. The Clean Air Act requires EPA to set national air quality standards for common pollutants based solely on protecting public health and welfare. In addition, the Act requires states or EPA depending on the program to set emissions standards or limits for air pollution sources such as power plants, industrial facilities or motor vehicles. These emissions standards may be designed to control common pollutants , toxic pollutants , or greenhouse gas pollution. In most cases, the Act calls for emissions standards to be set based on data concerning the emissions performance and cost of available technologies. In this way, technical feasibility and cost considerations are taken into account when pollution sources are regulated. Performance standards, not technology requirements In setting national emissions standards, EPA generally sets emissions performance levels rather than mandating use of a particular technology. In fact, the law mandates that EPA use numerical performance standards whenever feasible in setting national emissions standards for stationary sources. Depending on the program, additional flexibility may be provided through emissions averaging, emissions trading, alternative standards, or other mechanisms. The Act gives EPA authority to collect data from industries on emissions, control technologies and costs. EPA uses this and other technical information in issuing national rules, and places the information that EPA relies on in the rulemaking docket for public review and comment except confidential business information. EPA also collects information from states, and makes data on control technology performance available to states and the private sector in information clearinghouses. State limits based on technology performance and cost Under the Act, States also set emissions limits for pollution sources considering technology performance and cost. Promoting technology improvement Under some parts of the Act, Congress authorized standards that push development of technology. For example, in provisions for new motor vehicle standards, Congress authorized EPA to set performance levels that, while not achievable immediately, are demonstrated to be achievable in the future based on information available today. Standards based on the best performers Other emissions standard-setting provisions of the Act call for an approach that focuses on what the best performers in a particular industry are already doing in practice. For example, section requires EPA to set national emissions standards for major stationary sources of toxic pollution. For existing sources, EPA must set standards that require at least the level of performance already achieved by the top-performing 12 percent of similar sources. These provisions are designed to ensure that the higher-emitting sources in an industry make improvements and bring emissions in line with levels already achieved in practice by the lower-emitting sources. The resulting performance standards give all sources the flexibility to decide the most cost-effective way to comply.

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Chapter 4 : Future trends in emissions control technology for India â€“ BS VI and beyond

The emissions control manufacturing industry in India, represented by ECMA, has currently 15 member-companies manufacturing a large number of exhaust aftertreatment solutions and components that shall help OEM achieve these norms in future.

November 17, at Fossil-fuelled vehicles, although under threat from the disruption expected from electric prime-movers sometime in the future, still have to run cleanly, using appropriate aftertreatment till alternatives overtake their use. For the two types of fuel used principally, gasoline and diesel strategies differ as the industry moves towards a cleaner environment. The accompanying picture shows the various configurations of GPF that shall be used. A typical application of the options that shall be available for particulate matter and NOx control is illustrated here: The details of a NOx storage catalyst: Moving to heavy duty engines used in trucks and buses as well as for tractor and off-road applications , the principal strategy in future shall be a combination of DOC, DPF and SCR, including an ammonia slip catalyst. A typical configuration representing this is as illustrated here: For India, the important considerations are the achievement of temperatures required for efficient operation of SCR in the very varied operating conditions seen in applications. For example the same truck may operate within cities where roads are congested and traffic start-stop or slow, leading to low temperatures that the inhibit the efficiency of aftertreatment devices. Again, the same truck could be running inter-city and therefore the aftertreatment has to be engineered so that emission targets are met in both types operation. Different ranges of size, shape and material for the substrate as well as different types of coating for DOC, DPF and SCR technologies capable of meeting these challenges have been developed over the years. Typical options that shall be available for SCR are for substrates, coated or extruded, or even metallic monoliths. SCR coatings, either Vanadium, copper or iron-based exist, each having slightly different properties, to suit various types of applications and of course also cost! This brings us to the all-important cost aspect, as the Indian market is both cost and quality conscious, and although performance requirements per-force require that appropriately engineered architecture and materials have to be used, ECMA member-companies have the additional consideration for providing affordable solutions for India. Gosain who had been instrumental in building up ECMA to the level of recognition and competence that it enjoys today. Basu has been working in the automotive industry for over 40 years in different capacities. During his year stint at Tata Motors, he was instrumental in developing and getting Tata products certified for emissions at ARAI and later at European test agencies, as Tata began its thrust on exports to Europe. After having worked in engine development he moved to aftertreatment with Umicore Automotive catalysts in and was responsible for building the Indian market for Umicore, so that its catalyst facility in Pune could be commissioned. Widely recognised in the automotive fraternity, at OEM as well as test agencies and engineering service providers, as a knowledgeable and resourceful person, Mr. Basu has been tasked several times as trouble-shooter, successfully resolving issues innovatively. Now, with the very strong focus on technology and development for the stringent emission expected form fossil-fuelled vehicles and engines, a technically oriented person was required at the helm at ECMA. With vast knowledge and experience in powertrain, automotive emissions and regulatory framework globally, Mr. Basu was seen as the right candidate to head ECMA.

Chapter 5 : Automotive Emission Repair Information

The Vehicle Technologies Office (VTO) supports research and development of aftertreatment technologies to control advanced combustion engine exhaust emissions. All engines that enter the vehicle market must comply with the Environmental Protection Agency's emissions regulations.

Emissions measurement, data storage, reporting and evaluation, modeling and software What are emissions? Where do they come from? Emissions is the term used to describe the gases and particles which are put into the air or emitted by various sources. National Trends The amounts and types of emissions change every year. Air pollution regulations and emission controls also have an effect. The National Air Pollutant Emission Trends report summarizes long-term trends in emissions of air pollutants and gives in-depth analysis of emissions for the current year. The report also discusses emission evaluation and prediction methodologies. EPA calls this set of principal air pollutants, criteria pollutants. There are also a large number of compounds which have been determined to be hazardous which are called air toxics. Sources There are many sources of emissions. These have been grouped into four categories: Point sources include things like factories and electric power plants. Mobile sources include cars and trucks, of course, but also lawn mowers, airplanes and anything else that moves and puts pollution into the air. Since then additional laws and regulations have been added including the Amendments to the Clean Air Act. To read about these rules and regulations see: Clean Air Act - the Clean Air Act and its Amendments also includes an easy to read version Air Toxics Rules and Implementation - Air Toxics Rules and Implementation Measuring, reporting, and using emissions data Measurement In order to make improvements in the air quality, the amount of pollutants in the air must be measured. The Emissions Measurement Center develops standards and evaluates testing methods so that regulations can be developed and enforced. An emission factor is a relationship between the amount of emissions that are released and the activity of the producer. Emission factors are used to predict emission levels for different industries. What are Emission Inventories? Emission inventories are quantities of pollutants measured over time. Emission inventories can be compared with air pollutant levels in an area to determine if increased emissions decreases the air quality. Data Storage Once the measurements are made the information must be collected and stored so that it can be used to evaluate the air quality and effects of the regulations. Modeling The emissions data that is gathered is also used to create models which can help to predict what air quality will be like in the future and what effect new regulations might have on air quality.

Chapter 6 : Challenges in Emission Control Catalysis for the Next Decade | Johnson Matthey Technology F

Emission Control Technology, Current Air Quality Issues Farhad Nejadkoorki, IntechOpen, DOI: / Available from: Thanh-Dong Pham, Byeong-Kyu Lee, Chi-Hyeon Lee and Minh-Viet Nguyen (October 21st).

Corporate Average Fuel Economy standard, and also the proposed carbon dioxide standards in Europe. From this perspective, the use of a leaner burning engine with significantly improved fuel economy is extremely desirable and has significant impact on the design of emission systems and catalytic converters. As a result, the leaner burn diesel engine is expected to continue as a serious contender in the European Market, and as such has its own specific catalyst requirements 1 , and will be the subject of a future article in Platinum Metals Review. The lean burn gasoline engine, and the two-stroke engine are also likely to have some effect on emission control technologies towards the end of this decade. Engines, Emission Control and Catalysts Since the early s, the primary emission control system for four-stroke passenger car gasoline engines has consisted of the three-way catalytic converter, which is capable of simultaneously reducing hydrocarbons, carbon monoxide and nitrogen oxides emissions, see Figure 1. The three-way converter reaches maximum efficiency close to the stoichiometric air: Therefore the engine has to function at around the stoichiometric air: In addition, mass air sensors together with electronic fuel injection systems, which allow much more precise air: But because of the need to meet nitrogen oxides emission standards, a vehicle having an engine which operates at stoichiometry with a three-way catalytic converter is currently favoured. However, there is no doubt if an effective catalyst technology emerges, which could reduce nitrogen oxides under lean air: Advanced two-stroke gasoline engines, capable of meeting current emission control standards, are now under development. In contrast to the four-stroke engine, the two-stroke is a lean burn engine operating at air: It is clear that for these types of engines, the conventional three-way catalyst system would be incapable of reducing nitrogen oxides emissions, thus an alternate approach to control nitrogen oxides is required. Fuel Effects In addition to the complexities of producing new types of engine, further complications are emerging due to the proposed use of reformulated gasolines. Those gasolines with reduced sulphur content offer advantages in meeting lower emission targets, due to the removal of the inhibition of the catalyst by sulphur. Figure 2 shows the emissions from a vehicle measured over the U. Federal Test Procedure FTP using gasoline containing three different fuel sulphur levels 87, and ppm. These results are from the U. FTP In all cases the emissions increase as the fuel sulphur level increases. The greatest sensitivity to the fuel sulphur level is shown by the palladium-only catalyst for controlling nitrogen oxides. In contrast, the least sensitivity to fuel sulphur is also shown by palladium-only catalysts, for hydrocarbon control. The hydrocarbon control capability of palladium-only catalysts is currently attracting attention as an aid to meeting the stringent California hydrocarbon emission limits. Systems Design The most immediate need, both in Europe and the United States, is for catalysts that are more thermally durable. In the United States the achievement of the future emission standards is contingent upon increasing the efficiency of the catalytic converter system. The simplest approach to achieve that objective consists of mounting the catalyst close to the exhaust manifold so that the catalyst warms up faster. As a result, catalyst temperatures can be expected to be significantly higher, thus an improvement in the thermal durability of the catalyst is needed. In Europe, a similar requirement has emerged due to the use of smaller capacity, high revolution engines, which are used at much higher vehicle speeds. This, together with aiming to achieve stoichiometric calibration at all engine speeds, is resulting in a significant rise in the temperature of the exhaust and catalyst system. The requirement for a reduction in hydrocarbon emissions promulgated in the California standards has focused serious attention on controlling vehicle emissions during cold start. Under these conditions, large quantities of hydrocarbons can be emitted prior to the catalytic converter attaining its light-off temperature. To overcome this problem, several alternate technologies are under development. Catalyst research has concentrated on developing fast light-off catalysts, which minimise the time before which the catalyst becomes active. Electrically heated substrates are also available which heat the catalyst to above its light-off temperature either prior to or immediately after starting the engine. An alternate approach to controlling the hydrocarbon emissions produced during cold start is to use absorbent materials in the exhaust, which trap the hydrocarbon emissions before the catalyst becomes active and later release the emissions at higher temperatures. Due to limitations in the trapping materials used, these systems require complex arrangements of valves or heat exchangers in the exhaust system, and an extremely low light-off catalyst is required downstream to combust the emissions desorbed from the hydrocarbon trap. Thus, a broad picture emerges where the major thrust in catalyst development is towards producing catalysts capable of Teacting extremely quickly after vehicle operation under cold start conditions. This results in an additional requirement for catalyst coatings of high thermal durability, for use in close coupled positions to the engine, and which can withstand harsh operating environments for up to , miles. Catalyst Substrate Designs Virtually all emission control catalysts in use today are based on a monolith substrate design. The monolith may be either a ceramic or metallic construction, with cordierite being the preferred ceramic material, and ferritic steels being the preferred metallic material. The former is designed for low thermal expansion in order to maintain structural integrity and resistance to thermal shock. The latter is designed for oxidation resistance under high temperature conditions. Both substrates have a high surface area coating incorporating both base metals and noble metals to achieve the desired catalytic performance. Moving a converter close to the manifold often produces space constraints within the vehicle, with the result that small converter shapes are being installed ahead of the main catalytic converter. The installation of small converters with smaller frontal areas produces flow constriction in the exhaust system and higher pressure drop. This results in power loss from the engine, which is often unacceptable to the automotive designer. One approach to reduce the power loss is to develop thin walled substrate systems, which reduce the pressure drop. A significant increase in the intrinsic strength of the ceramic body is a necessary requirement for these thin walled substrates, so that they can withstand the canning pressures required during the insertion of the catalyst into the converter shell. This, in turn, requires a modification to the basic structure of the ceramic, especially with respect to its porosity, and also the development of adherent coatings for the new ceramic structure. All this has been successfully achieved, so that the efficiency of a thin walled substrate catalyst is comparable to that of a conventional catalyst. Early problems with the mechanical integrity of metal substrate systems have now been largely resolved, by improvements in fabrication technology. Metal substrates are now finding application, particularly on vehicles with small engines, where space is at a premium. The inherent benefit of using metal supports of thin walled structure has been in the lower pressure drop, and this has helped metal substrates to be accepted for such applications. At present, attention is focused on developing metal substrates as electrically heated supports. These may be used to treat emissions during vehicle cold start, when hydrocarbon emissions are high, see Figure 3. Two principal types of metal support structures are under development. FTP test for a vehicle being driven from a cold start and run over a number of hills The first consists of insulated layers of metal foil, and the second consists of an extruded powder metal support, in which the electrically conducting path is controlled through slots in the substrate. Both types of support systems have been evaluated as electrically heated catalysts EHC , operating in conjunction with conventional three-way catalytic converters. Emission levels at or below those required for the California ULEV standards have been achieved on prototype systems, as Table II shows, and the durability of the systems are currently being evaluated. Future developments in this area are concentrating on reducing the power consumption required for electrical heating and on optimising battery and alternator systems.

Chapter 7 : Emissions Control Technology - Prairie State Energy Campus

With new automobile emission standards going into effect in Europe, and even tougher standards ready for implementation in California and the rest of the United Stares, automotive emission control systems are required to perform even better, in the ongoing effort to reduce vehicle emissions.

For example, the development of transportation has dramatically extended the range of human activities, genome research makes personalized medicine possible, and the advancement of information and communications technology ICT has minimized time and distance in communications. Therefore, it is essential to control the negative aspects on the one hand and develop the positive factors on the other. In this context, we need appropriate midterm strategies to advance two aims: The downside of fossil fuels In the 20th century, many advanced countries relied on fossil fuels such as coal and oil for generating energy. These energy resources have brought great benefits for large-scale economic activities, mass production, and global transportation. However, fossil fuels have a downside for humankind. Consumption of oil is responsible for emissions of greenhouse gases to the atmosphere, climate change, and air pollution. And because oil is a limited resource, it is subject to great increases in price. Therefore, Japan and the world face a daunting array of energy-related challenges. In view of the expected increase in global energy needs and of environmental concerns, we need to make rapid progress in energy efficiency and further develop a broad range of clean alternative energy sources to reduce emissions and solve climate change problems. Many developed countries have been making concentrated efforts to develop alternative energy sources, such as nuclear energy and solar power. I strongly believe that nuclear energy should be the main alternative to fossil fuels. In Japan, power from nuclear generation is less expensive than power generated from oil. Furthermore, climate change and escalating oil prices have persuaded some countries that had adopted a cautious stance toward nuclear energy to change their minds and seriously consider it as an alternative. Although developing other alternative energy sources, including solar power, is also undoubtedly important, ever-increasing energy demands cannot be met unless we use atomic energy. Where mobility for humankind is concerned, however, almost all types of transportation are still highly dependent on fossil fuels because gasoline- and diesel-powered vehicles are predominant throughout the world. Even if various countries develop and use alternative energy generation systems, they cannot survive without petroleum-derived fuels, which power transport. In other words, right now there is no effective alternative. Oil is produced in only a handful of countries, and because it is indispensable for transportation, those countries exert crucial influence on the rest of the world. The oil-producing countries sometimes control production and export volume, leaving other countries to cope with higher oil prices. Some advanced countries have highly developed electric public transportation networks, such as trains or subways, but these have two main drawbacks. First, such largescale public transportation systems are applicable mainly in urban areas. In rural areas where the population is relatively sparse, such systems are not really practical. Second, automobiles offer people the freedom to move about at will. Economic development gives people the freedom to work and engage in leisure as they please, so personal mobility is important. Thus, it is sometimes difficult for people who are accustomed to personal mobility to shift to mass public transportation. In the last decade of the 20th century, some farsighted automobile manufacturers developed hybrid vehicles. Toyota has been making and selling its petroleum electric hybrid vehicle since This system improves energy efficiency, but such vehicles still depend on gasoline for fuel. There is no price elasticity, and the pricing mechanism is not working effectively. This illustrates the fact that transportation is much more oil-dependent than electricity generation, and existing technologies offer few fundamental solutions for alternatives in the transportation sector. Alternative energy for transportation It seems clear that it is necessary to develop alternative energy sources for transportation to replace fossil fuel. Developing these two key technologies in the next five years will have a decisive impact on our future and will help establish an economic mechanism with which oil prices can be contained within a reasonable range. If these two systems can be commercialized, they will help lower both oil prices and carbon dioxide emissions. In Japan, the cost of generating nuclear power is competitive with that of thermal power generation such as oilfired power plants. And in terms of energy for transportation, the energy source for both EVs and FCVs is electricity, which can be generated from nuclear power. For example, EVs use electricity directly to charge their batteries, and FCVs are powered by hydrogen, which is produced using electricity. In this way, it is possible to inject nuclear energy into transportation. This structure would stabilize the price of oil and at the same time save fossil fuels and alleviate climate change, achieving sustainability for our planet. If the technical challenges in these two convincing technologies can be overcome, the energy costs of these systems could be an important component for placing an upper limit on oil prices. In other words, it is essential to concentrate on cutting the cost of these new systems, in addition to solving the technical difficulties. One of the key merits of FCVs is high power-generation efficiency, because unlike a normal generation system, the system does not depend on the Carnot efficiency peculiar to thermo motors. EVs also offer advantages. The first is that electric motors are mechanically very simple and release almost no air pollutants in operation. The second is that, whether at rest or in motion, electric vehicles typically produce less vibration and noise pollution than vehicles powered by an internal combustion engine. However, there are challenges to overcome before these two technologies can be applied. One main technological hurdle for FCVs is the difficulty of maintaining the integrity of the pressure vessel and the separation membrane, which degenerates throughout the operating period. In the case of EVs, drawbacks are the relatively short travel distance on one charge of the battery, short battery life, and the large amount of electricity needed to charge an EV battery. Researchers thus need to concentrate their efforts on solving these technological challenges. The sooner these new energy systems become competitive with conventional gasoline-powered vehicles, the further ahead we will be in achieving sustainability. I would like to see this new technology in viable form within the next five years, and that will require more government investment and creation of model projects in these areas. Developing alternative energy for transportation, in sum, will stimulate competition among fuels, keep fossil fuel prices at reasonable levels, and slow climate change. Therefore, the technologies making this possible must be further developed. But in the 21st century, we have come to recognize that these resources are finite. With progress in technology, automobiles are everywhere, almost everyone uses electricity, large quantities of energy are consumed, and the population has grown. Humankind has prospered up to now, but for the sake of our future survival, we must change our economic behavior and daily life to reflect the fact that Earth is finite. However, this strategy will not become reality unless all of us, including policymakers, scientific experts, and the general public, recognize that we need to preserve our finite and priceless planet. If new energy sources for transportation become competitive, public behavior will change and vehicles propelled by new energy will sell. Energy for transportation will become less expensive and carbon dioxideâ€”free transportation will become a reality, thus contributing to sustainability. But we must recognize that human activities are also part of the universe. What we can do to harmonize our lives with nature in the future is the most important issue for humankind today. We must ensure that economic growth and environmental preservation can coexist. But whether this sustainability will work for 50 or years or whether it will last for or 1, years into the future depends on shared awareness that the planet is finite. Our discussions at the STS forum are based on the idea that humankind is part of the universe and on the philosophy of harmony with nature. At this conference, a postâ€”Kyoto Protocol framework should be built up with the participation of all countries, including the United States, China, and India. Everyone must realize that taking this action is for the benefit of humankind. Humankind shares a common destiny. I hope that technological progress and policy action on alternative energy for transportation will benefit society and lead us on the road to sustainability, in harmony with nature for a long and bright future for humanity. Koji Omi, a member of the Japanese House of Representatives and a former minister of finance and minister of state for science and technology policy, is the founder and chairman of the Science and Technology in Society forum. Share Cite this Article.

Chapter 8 : Global Warming Solutions: Reduce Emissions | Union of Concerned Scientists

Emissions tests on diesel cars have not been carried out during MOTs in Northern Ireland for 12 years, despite being legally required. Emissions control. Engine efficiency has been steadily improved with improved engine design, more precise ignition timing and electronic ignition, more precise fuel metering, and computerized engine management.

The vehicles tested were anonymous in the original study. Emissions listed on page Limits listed on page 5. NOx treatment listed on page 9. Shin Bet apparently knew about the scandal early. Primor confirmed that the meeting took place, but both Primor and Diskin denied tipping off Piech. I am stunned that misconduct on such a scale was possible in the Volkswagen Group. As CEO I accept responsibility for the irregularities. I am doing this in the interests of the company even though I am not aware of any wrongdoing on my part. Bosch provided the software for testing purposes and warned VW that it would be illegal to use the software to avoid emissions compliance during normal driving. These are prohibited in the United States, however the software is legal in Europe. SEAT said that , of its diesel models were affected. In Europe alone, a total of 8 million vehicles are affected. In Portugal, VW said it had sold 94, vehicles with the software. As the rules violation involved enabling emission controls during testing, but turning it off under normal conditions to improve performance or fuel mileage, it has been speculated that the software update might make cars perform less efficiently and impair fuel economy ; according to VW, however, its proposed solutions will be designed to achieve legal EU emissions compliance without impairing engine performance or consumption. The company also announced a review of all of its brands and models, including its supercar marque Bugatti. He said that the fixes would likely preserve fuel economy ratings but, "there might be a slight impact on performance". It also announced plans to accelerate the development of electric cars and plug-in hybrids, as well as petrol, instead of diesel engines for smaller cars. VW then decided to recall around 8. The German authorities require that VW removes the software and that VW ensures that emission rules are fulfilled. German motoring journal Auto Motor und Sport tested two Amarok TDI pickups pre and post software update and found that whilst engine power had remained the same, fuel consumption had increased by 0. This was a couple of software engineers who put this in for whatever reason All the indications are that residual values are unaffected"; [] the company, which continued to face pressure from E.

Chapter 9 : Volkswagen emissions scandal - Wikipedia

Today, viable emission control technologies exist to reduce diesel exhaust emissions from both new engines and vehicles, as well as in-use engines through the use of retrofit kits.

Emissions that are principal pollutants of concern include: Hydrocarbons HC - A class of burned or partially burned fuel , hydrocarbons are toxins. Hydrocarbons are a major contributor to smog , which can be a major problem in urban areas. Prolonged exposure to hydrocarbons contributes to asthma , liver disease , lung disease , and cancer. Regulations governing hydrocarbons vary according to type of engine and jurisdiction ; in some cases, "non- methane hydrocarbons" are regulated, while in other cases, "total hydrocarbons" are regulated. Technology for one application to meet a non-methane hydrocarbon standard may not be suitable for use in an application that has to meet a total hydrocarbon standard. Methane is not directly toxic, but is more difficult to break down in fuel vent lines and a charcoal canister is meant to collect and contain fuel vapors and route them either back to the fuel tank or, after the engine is started and warmed up, into the air intake to be burned in the engine. Carbon monoxide persistently binds to hemoglobin, the oxygen-carrying chemical in red blood cells, where oxygen O2 would temporarily bind; the bonding of CO excludes O2 and also reduces the ability of the hemoglobin to release already-bound oxygen, on both counts rendering the red blood cells ineffective. Removing a person from a CO-poisoned atmosphere to fresh air stops the injury but does not yield prompt recovery, unlike the case where a person is removing from an asphyxiating atmosphere [i. Toxic effects delayed by days are also common. NOx - Generated when nitrogen in the air reacts with oxygen at the high temperature and pressure inside the engine. NOx is a precursor to smog and acid rain. NOx production is increased when an engine runs at its most efficient i. Particulate matter â€” Soot or smoke made up of particles in the micrometre size range: Particulate matter causes negative health effects, including but not limited to respiratory disease and cancer. Very fine particulate matter has been linked to cardiovascular disease. Sulfur oxide SOx - A general term for oxides of sulfur , which are emitted from motor vehicles burning fuel containing sulfur. Reducing the level of fuel sulfur reduces the level of Sulfur oxide emitted from the tailpipe. Volatile organic compounds are a subsection of Hydrocarbons that are mentioned separately because of their dangers to public health. This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. November Learn how and when to remove this template message Throughout the s and s, various federal, state and local governments in the United States conducted studies into the numerous sources of air pollution. These studies ultimately attributed a significant portion of air pollution to the automobile, and concluded air pollution is not bounded by local political boundaries. At that time, such minimal emission control regulations as existed in the U. The ineffective local regulations were gradually supplanted by more comprehensive state and federal regulations. Both agencies, as well as other state agencies, now create and enforce emission regulations for automobiles in the United States. Similar agencies and regulations were contemporaneously developed and implemented in Canada , Western Europe , Australia , and Japan. The first effort at controlling pollution from automobiles was the PCV positive crankcase ventilation system. Positive crankcase ventilation was first installed on a widespread basis by law on all new model cars first sold in California. The following year, New York required it. By , most new cars sold in the U. Also in , the first emission test cycle was enacted in the State of California measuring tailpipe emissions in PPM parts per million. The standards were progressively tightened year by year, as mandated by the EPA. By the model year, the emission standards had tightened such that the de-tuning techniques used to meet them were seriously reducing engine efficiency and thus increasing fuel usage. The new emission standards for model year, as well as the increase in fuel usage, forced the invention of the catalytic converter for after-treatment of the exhaust gas. This was not possible with existing leaded gasoline , because the lead residue contaminated the platinum catalyst. In , General Motors proposed to the American Petroleum Institute the elimination of leaded fuels for and later model year cars. All modern cars are now equipped with catalytic converters, and leaded fuel is no longer sold at filling stations in most First World countries. Leaded racing fuel is available in small quantities from some suppliers, but it is legal for off-road use only. Regulatory agencies[edit] The agencies charged with regulating exhaust emissions vary from jurisdiction to jurisdiction, even in the same country. For example, in the United States, overall responsibility belongs to the EPA, but due to special requirements of the State of California, emissions in California are regulated by the Air Resources Board. In Texas, the Texas Railroad Commission is responsible for regulating emissions from LPG -fueled rich burn engines but not gasoline-fueled rich burn engines.