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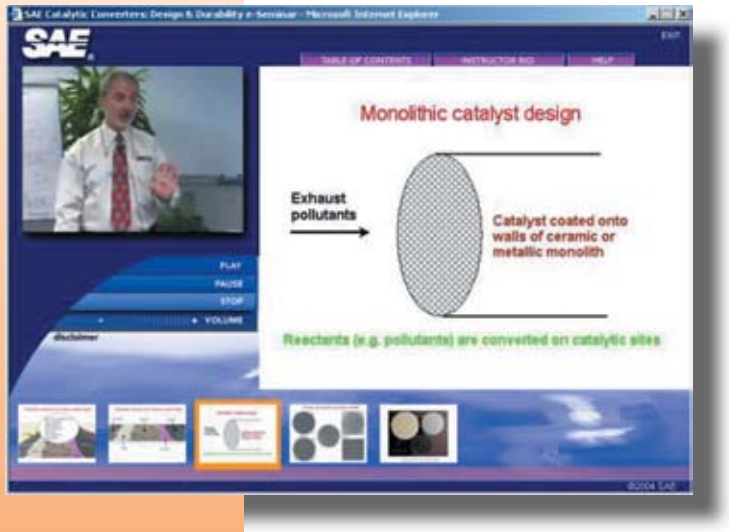
NEW Catalytic Converters: Design and Durability e-Seminar



Expand your knowledge of catalytic converter chemical and mechanical principles from your desktop.

- Prepare for discussions with catalyst manufacturers by reviewing the concept of catalysis
- Describe why ceramics as structural materials behave differently than metals and how such differences affect product design and performance
- Design catalytic converters which have adequate durability to meet performance and reliability requirements in the field
- Work with advanced catalyst systems which help meet stringent emissions regulations, such as LEV, ULEV, and SULEV
- Examine field failures and conduct root cause analyses to help improve converter design
- Appreciate the need for a systems approach and the tradeoffs between catalyst performance and engine controls in the design of emission controls for vehicles

Introducing SAE e-Seminars

Convenient, portable, and with core content not reliant on live web connectivity, **SAE e-Seminars** offer a new way to receive the same instruction as live classroom learning without the expense of travel and time away from the workplace. e-Seminars deliver classroom seminar content on CD-ROMs, featuring full-motion video illustrated with synchronized presentation slides.

The seminar content is presented in two parts divided into twelve modular topics, allowing you to progress through the course at your own pace. The program interface offers linear progression through the video, as well as the flexibility to pause or review specific concepts and to jump to individual slides from the table of contents. Handout materials and a textbook are included, making the e-Seminar a complete a ready-reference package, available whenever and wherever a refresher is needed. A self-quiz is available before taking the course and an online post-test will gauge new knowledge. Upon completion, you will receive 1.3 CEUs and obtain an SAE certificate of completion.

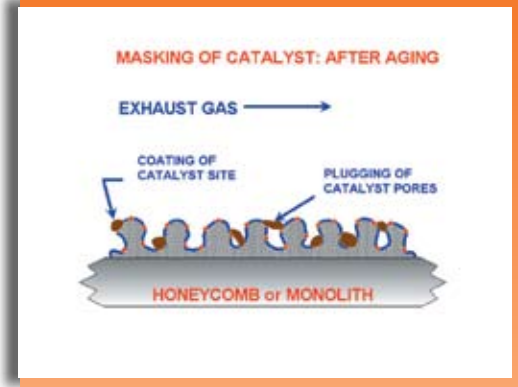
Catalytic Converters: Design and Durability e-Seminar

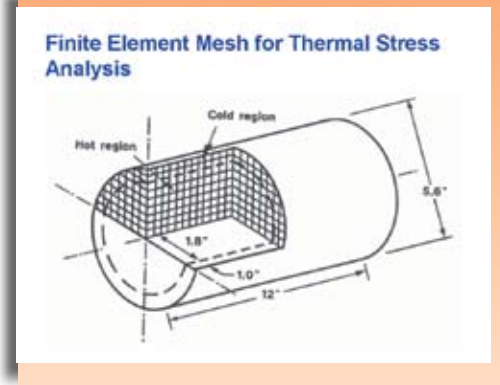
This e-seminar takes you from the early development of catalytic converters and the key inventions that made them viable, to the recent advances in converter technology required to meet the ever-stringent emissions regulations for both light-off and underbody converters. Applications of converter design to gasoline-powered cars, trucks and motorcycles are presented, in particular, the choice of materials; the design, durability and performance of various components that comprise the converter system; the importance of packaging design necessary to ensure 100k vehicle mile durability; and the sizing of the converter as it relates to conversion efficiency, backpressure and physical durability. Based on the popular classroom seminar, the ten-hour, 45-minute course is divided into twelve modules on four CDs, and is accompanied by a handbook and a textbook.

Is this e-Seminar for You?

If you are a mechanical, metallurgical or chemical engineer, materials scientist, or chemist involved in heterogeneous catalysis who is interested in handling, assembling, and failure analysis of catalytic converters, this e-Seminar is for you. It is recommended that you have a basic familiarity with automotive emissions for gasoline engines to get the most benefit from this course.

Modern Three Way Catalyst (TWC)





Instructors: Suresh Gulati and Ronald Heck

Dr. Suresh Gulati is the author of over 200 publications in the areas of ceramic catalyst supports, fiber optics, liquid crystal display glasses, cathode ray tubes, space windows, automotive windshields, and stepper lenses made from high purity fused silica. He was a Research Fellow in the Science and Technology Division of Corning, Inc. where he specialized in the behavior of glass, glass- ceramics and ceramics subjected to mechanical and thermal loads, their fatigue and fracture properties and their long-term reliability. Before joining Corning, he held positions with Cornell University, the University of Colorado, and Continental Can Company. He holds 10 U.S. patents on novel glasses and automotive substrates, and was named an SAE Fellow in 1993. Dr. Gulati has a Ph.D. in applied mechanics from the University of Colorado, an M.S. in mechanical engineering from Illinois Tech and a B.S. in mechanical engineering from the University of Bombay in India.

Dr. Ron Heck is currently an independent consultant. Prior to that, he was a research manager responsible for developing automotive catalyst technology for Engelhard Corporation's worldwide customers. He has worked on the development of catalytic processes in SCR NOx, NSCR NOx, automotive catalyst, diesel catalyst, PremAir™ catalyst systems, hydrogenation technology, ozone abatement, volatile organic compound abatement, ammonia oxidation, chemical feedstock purification, and chemical synthesis. Dr. Heck is the author of over 80 publications in commercial applications of catalysts and holds 30 U.S. patents on catalytic processes. He is co-author of the book *Catalytic Air Pollution Control: Commercial Technology*, and is co-editor of the NewsBrief section of *Applied Catalysis B: Environmental*. Dr. Heck was awarded the Fellow Grade of SAE membership in 2003 to honor his significant engineering, scientific and technical leadership achievements. Dr. Heck holds a B.S. in chemical engineering and a Ph.D. from the University of Maryland.

e-Seminar Content/Objectives

Part I: Chemical Principles

Module I: Brief Historical Background/ Fundamentals of Catalysis

[Total Run Time: 2 hours, 13 minutes]

- Identify critical automotive emissions and their sources
- Discuss why emission control is required
- Define a catalyst, its nomenclature, and its characteristics
- Discuss catalytic reactions and key steps in catalyst preparation
- Describe the differences between the four catalyst supports and the rationale behind the selection of honeycomb supports for automotive applications
- Summarize the various methods for catalyst characterization and how they are applied
- Assess the key mechanisms of sintering, masking, poisoning, and attrition and how they affect catalyst durability
- Discuss the main reaction controlling mechanisms
- Examine the trade-off of pressure drop and mass transfer conversion as applied to catalytic reactor design

Module II: Automotive Catalysis

[Total Run Time: 1 hr, 34 mins]

- Relate to the historical development and advancements in automotive catalyst technology and how they may be applied today to developing markets
- Examine the engine out emissions from a spark-ignited internal combustion engine
- Compare the key concepts in three-way catalysis (TWC)
- Grasp the importance of the initial engine control technology using the oxygen sensor
- Discuss the role of Ceria as a component in TWCs and advancements in improving thermal stability
- Distinguish the use of the dual oxygen sensor approach for monitoring of catalyst performance for hydrocarbon removal monitoring (OBD)
- List the key factors that led to the invention of the Palladium TWC technology and gain a basic understanding of layered catalyst technology
- Review primary test procedures and explain key differences

Module III: Automotive Catalysis Advanced Technologies

[Total Run Time: 1 hour, 20 minutes]

- Recognize the new California and Federal passenger car standards and their impact
- Discuss the importance of the initial emissions from the engine
- Explain the significance of the high-temperature, thermally stable, close coupled catalyst
- Express the concepts of hydrocarbon traps and electrically-heated catalysts, the studies that occurred to develop these as potential solutions for cold start emissions, and the eventual drawbacks of the technologies
- Identify the potential markets for metallic honeycombs
- Discuss the advances in engine control strategies, the synergism with the performance of the TWC, and the need for a new sensor, the UEGO air/fuel sensor
- Review the published designs of vehicles that meet California's ultra low and super ultra low emission standards
- Grasp the importance of the new engine designs for cold start and air/fuel ratio control
- Recognize the importance and benefits of new high cell density honeycombs, a system approach for ULEV and SULEV vehicle designs, and the interaction between catalyst technology and engine control

Module IV: Automotive Catalyst Durability Examples

[Total Run Time: 22 mins]

- List the causes for loss of performance of a catalytic system in end use as well as procedures to develop aging methods to simulate in use performance
- Discuss the current methods used to age catalysts on engine test stands in preparation for certification testing, the differences in the aging methods, and the possible effect of these differences on catalyst performance
- Anticipate the effects of sintering on catalyst performance
- Restate why masking is an important mechanism for decline in catalyst performance for SULEV applications
- Express the concept of catalyst poisoning and relate why low sulfur and unleaded fuels are important for durable catalyst performance
- Investigate the role attrition plays in catalyst durability
- Show why simple bench scale reactor tests are a key element in diagnosing the loss in catalyst performance

Module V: Lean Burn Engines

[Total Run Time: 35 mins]

- Compare stoichiometric vs. lean burn engine
- Illustrate the key engine emission issues in regards to NOx
- List the methods investigated for NOx removal
- Identify why direct NOx decomposition doesn't work
- Review the research for catalysts devoted to direct NOx catalytic reduction with hydrocarbons and the present status of this technology
- Recognize the past ten years of research devoted to NOx traps, the issues involved, the engine operational strategy to achieve performance, and the current state of this technology
- Compare the differences between direct NOx reduction using hydrocarbons and selective removal with NH3

Part II: Mechanical Principles

Module I: Brief Historical Background

[Total Run Time: 1 hour, 11 minutes]

- Discuss what led to the passage of Clean Air Act of 1970
- List alternate approaches to reducing exhaust emissions
- Summarize the early developments of honeycomb catalyst supports
- Understand the innovations required for successful manufacturing

Module II: Design of Catalyst Supports

[Total Run Time: 49 minutes]

- Relate key requirements for designing catalyst supports
- Describe geometric properties of honeycomb structures
- Restate the importance of ceramic cell wall porosity
- Explain key mechanical and thermal properties
- Predict the effect of cell size and wall porosity
- Estimate the size of catalyst support required for a given engine
- Compute performance parameters and examine trade-offs

Module III: Substrate-Washcoat Interaction

[Total Run Time: 19 minutes]

- Calculate the effect of washcoat on properties of catalyst supports
- Demonstrate the importance of substrate-washcoat adhesion
- Compute performance parameters and examine trade-offs before and after coating

Module IV: Packaging Design

[Total Run Time: 39 minutes]

- List the various components of converter assembly
- Explain the requirements for durable converter package
- Review the key properties of converter
- Estimate gap bulk density to ensure long-term durability
- Examine the distribution of holding pressure

Module V: Thermal Shock Resistance

[Total Run Time: 46 minutes]

- Describe development of in-use temperature gradients
- Measure above gradients using thermocouples
- Appraise the effect of gradients on thermal stresses during heating, cooling, and coasting
- Classify factors that influence thermal stresses
- Predict potential failure modes due to thermal stresses

Module VI: Advances in Catalyst Supports

[Total Run Time: 29 minutes]

- Distinguish between thin and ultrathin wall substrates
- Demonstrate the importance of high surface area and low
- Examine the effect of different cell shapes and sizes
- Identify trade-offs between performance and durability

Module VII: Ceramic vs. Metallic Substrates

[Total Run Time: 31 minutes]

- Compare geometric, mechanical and thermal properties of ceramic and metallic supports
- Analyze pressure drop in ceramic vs. metallic supports
- Contrast light-off and steady state conversion performances
- Differentiate high temperature behavior of both supports

***For classroom version, see back panel.**

Package Contents:

- Four CDs
- Course Handbook
- Instructor Ron Heck's text, *Catalytic Air Pollution Control: Commercial Technology*
- Online Pre-test (self-test, immediate results)
- Online Post-test (submit to SAE)
- Application for CEUs/Certificate of Completion

Equipment Requirements:

- PC Pentium class 200 MHz or better
- Windows 98 or later
- CD-ROM Drive
- Sound Card, and Speakers/Headphones
- 800 x 600 screen resolution or greater (1024 x 768 recommended)
- 32 MB of RAM or better
- Windows Media Player 7 or above
- Internet Explorer 4.0 or higher

Order No: PD130405
List: $1,095; SAE Members: $995
Single-user price
CEUs: 1.3

To order or for quantity or site license pricing:

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Related Resources from SAE International

CLASSROOM VERSION **Catalytic Converters: Design and Durability Seminar**
This seminar explores the development of catalytic converters and the key inventions that made them viable, along with recent advances in converter technology required to meet stringent emissions regulations for both light-off and underbody converters. *(I.D.# 98017)*

Diesel Emissions and Aftertreatment Devices Design and Durability Seminar
Topics presented in this comprehensive seminar include: progress in combating diesel emissions using oxidation catalysts; catalyzed "trap"; continuous regeneration "trap"; fuel additives; lean NOx catalyst; NOx "trap"; ammonia-based selective NOx reduction; plasma technology; filter materials; and sensor and on-board technology. *(I.D.# C0206)*

2004 SAE Engines Technology Collections on CD-ROM
With over 2,000 key SAE technical papers in each subject area, these collections deliver instant access to the latest technical information available in the industry.

Diesel Engines Technology Collection
(ENGD2004; $425 List/$340 Member)

Emissions Technology Collection
(EMISS2004; $450 List/$360 Member)

Spark-Ignition Engines Technology Collection
(ENGSI2004; $425 List/$340 Member)

Homogeneous Charge Compression Ignition (HCCI) Engines: Key Research and Development Issues
By Dennis N. Assanis, Paul M. Najt, John E. Dec, James A. Eng, Thomas N. Asmus, and Fuquan Zhao
This book gathers contributions from experts in both industry and academia, providing a basic introduction to the state-of-the-art of HCCI technology, a critical review of current HCCI research and development efforts, and perspective for the future. Each chapter features select materials and designs of various components that comprise the converter system will be reviewed. *(PT-94; $129.95 List/$103.96 Member)*

Exhaust Flow Performance and Pressure Drop of Exhaust Components and Systems Seminar
This course will help you to understand the motion of exhaust flow in both gasoline and diesel emission control components including flow-through and wall-flow devices such as catalytic converters, NOx adsorbers, diesel oxidation catalysts, diesel particulate filters as well as flow through the overall exhaust system. *(I.D.# C0235)*

Diesel Engine Technology Seminar
This course will explain the fundamental technology of diesel engines starting with a short but thorough introduction of the diesel combustion cycle, and continue with aspects of engine design, emission control design, and more. An overview of developing technologies for the future with a comprehensive section on exhaust aftertratment is also included. *(I.D.# 93014)*

Also available as an e-seminar: PD130312; $995 List/$895 Member

Visit store.sae.org for complete schedules, product information, and pricing on these related SAE resources.