

Disclaimer

The views expressed in this paper are the views of the author and do not necessarily reflect the views or policies of the Asian Development Bank (ADB), or its Board of Directors or the governments they represent. ADB makes no representation concerning and does not guarantee the source, originality, accuracy, completeness or reliability of any statement, information, data, finding, interpretation, advice, opinion, or view presented.



ROLE OF FUELS AND LUBRICANTS FOR EMISSION CONTROL IN TWO STROKE ENGINES

By

R. K. Malhotra

Indian Oil Corporation - R&D Centre

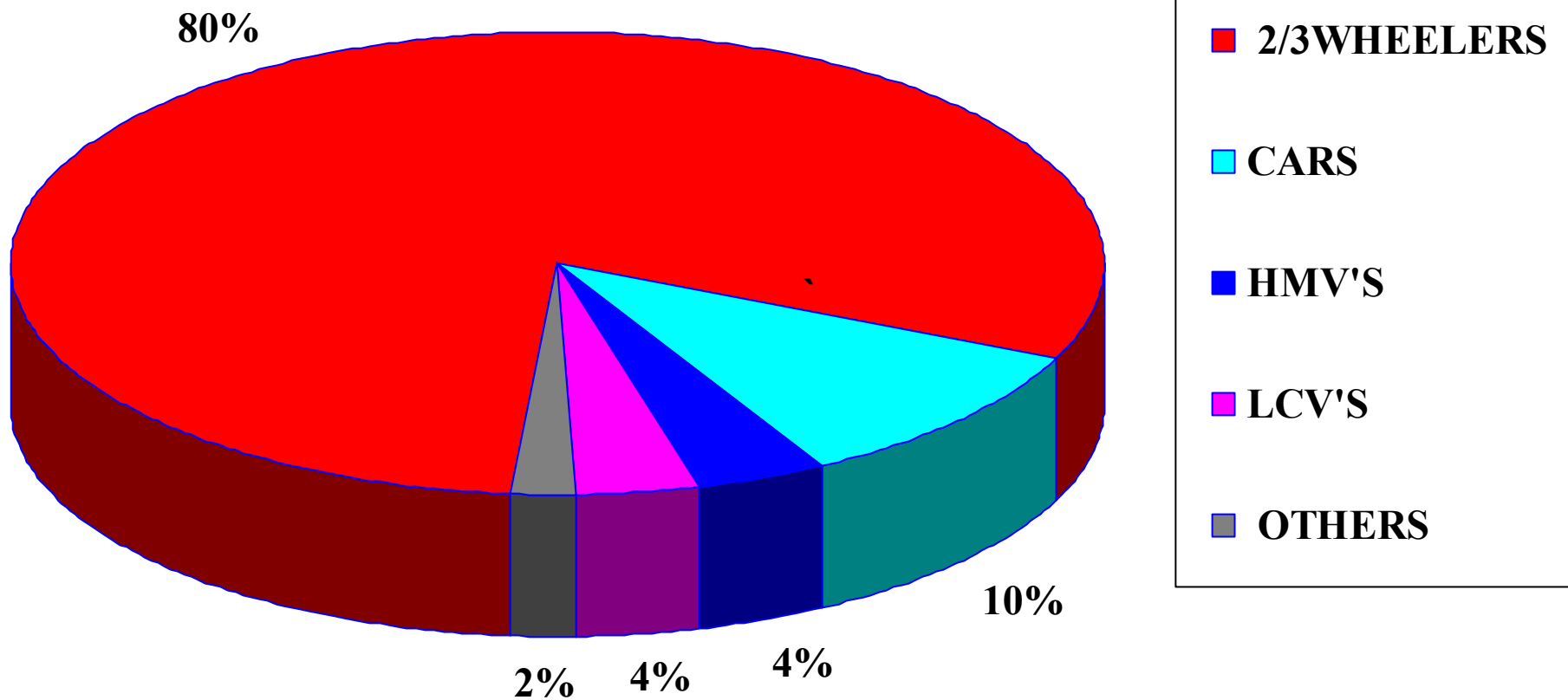
Faridabad, India

ADB Workshop, Hanoi, Vietnam

6th September, 2001



SHARE OF 2/3 WHEELERS IN TOTAL AUTOMOBILE POPULATION IN INDIA



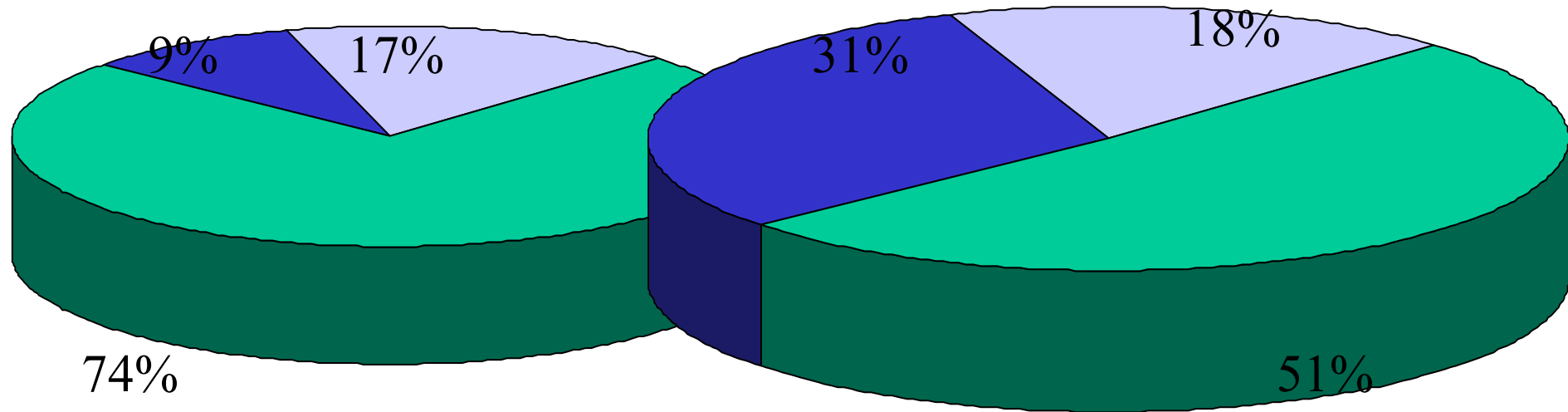
Total Contribution of Pollutants from Automotive Vehicles



Carbon Related Emission

Hydrocarbons

Carbon Monoxide



2/3 wheelers

Passenger Cars

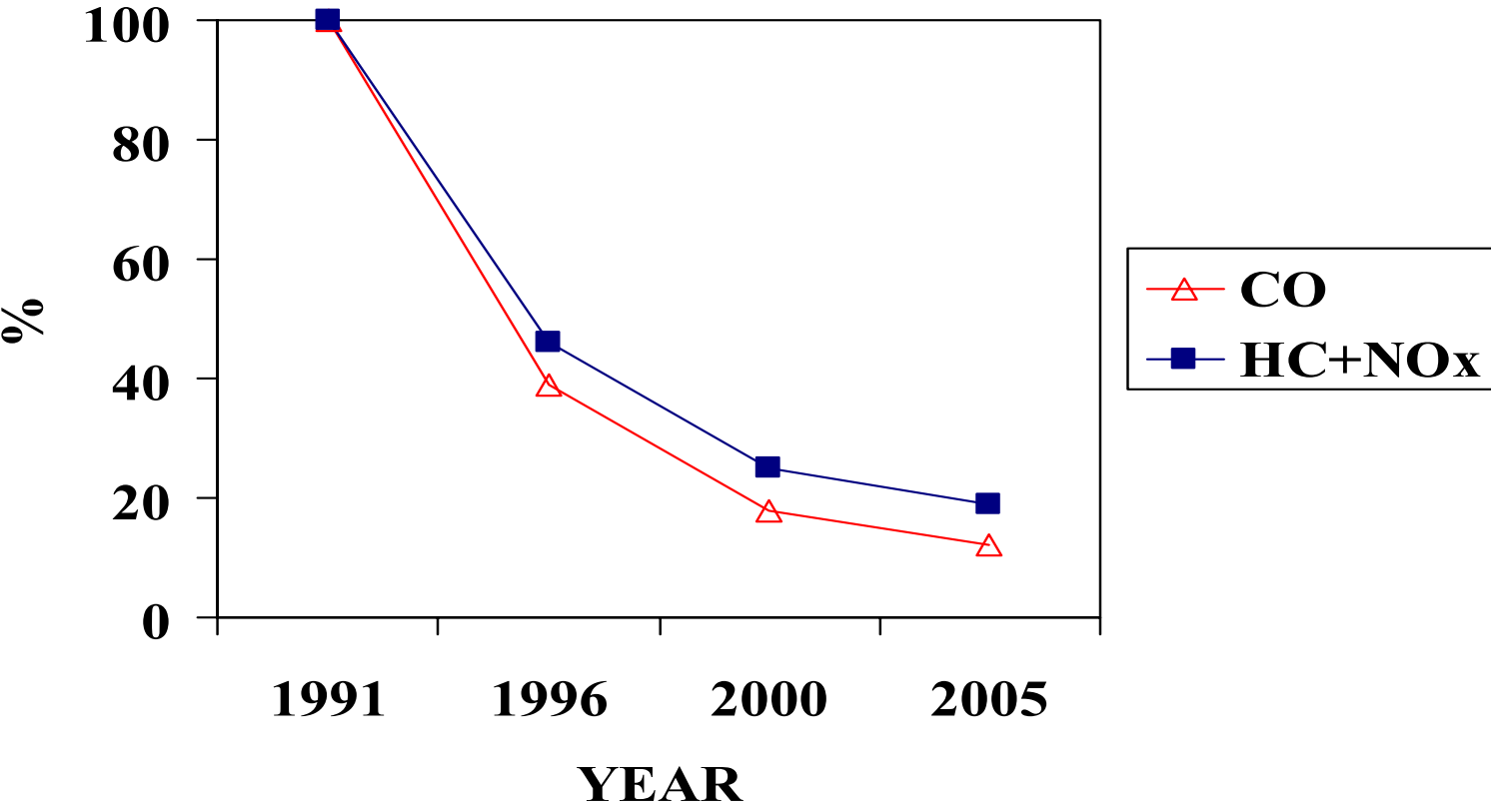
Diesel Vehicles

2/3 Wheelers Are Major Vehicle Polluters

MAJOR CONCERNS OF POLLUTION FROM 2 STROKE VEHICLES IN INDIA

- **EMISSIONS ON ACCOUNT OF LARGE POPULATION OF 2/3 WHEELERS**
 - **Hydrocarbons and Carbon Monoxide**
 - **Smoke and Particulates (from 2 – stroke engines)**
- **EMISSIONS FROM OLDER IN-USE VEHICLES**
- **POOR MAINTENANCE OF IN-USE VEHICLES**
- **POOR TRAFFIC MANAGEMENT**
- **ADULTERATION OF FUELS & USE OF SPURIOUS LUBRICANTS**
- **LACK OF EDUCATION WITH REGARD TO CORRECT OIL TO FUEL RATIOS**

PROGRESSIVE REDUCTION OF EMISSION NORMS FOR 2-WHEELERS IN INDIA



ENGINE TECHNOLOGIES FOR EMISSION CONTROL FROM 2&3 WHEELERS

PRESENTLY BEING PURSUED

- LEANER FUEL RATIO & ELECTRONIC IGNITION
- IMPROVEMENT IN COMPRESSION RATIO
- IMPROVED COMBUSTION CHAMBER DESIGN
- BETTER SCAVENGING
- IMPROVED SILENCER OPTIMISATION
- CHANGEOVER TO FOUR STROKE ENGINES
- REDUCED OIL FUEL RATIOS
- USE OF OXIDATIVE CATALYTIC CONVERTER

POTENTIAL TECHNOLOGIES

- ELECTRONIC ENGINE MANAGEMENT
- FUEL INJECTION SYSTEM
- FOUR STROKE ENGINES WITH CATALYTIC CONVERTERS

ROLE OF FUEL IN EMISSION CONTROL FROM 2 STROKE VEHICLES

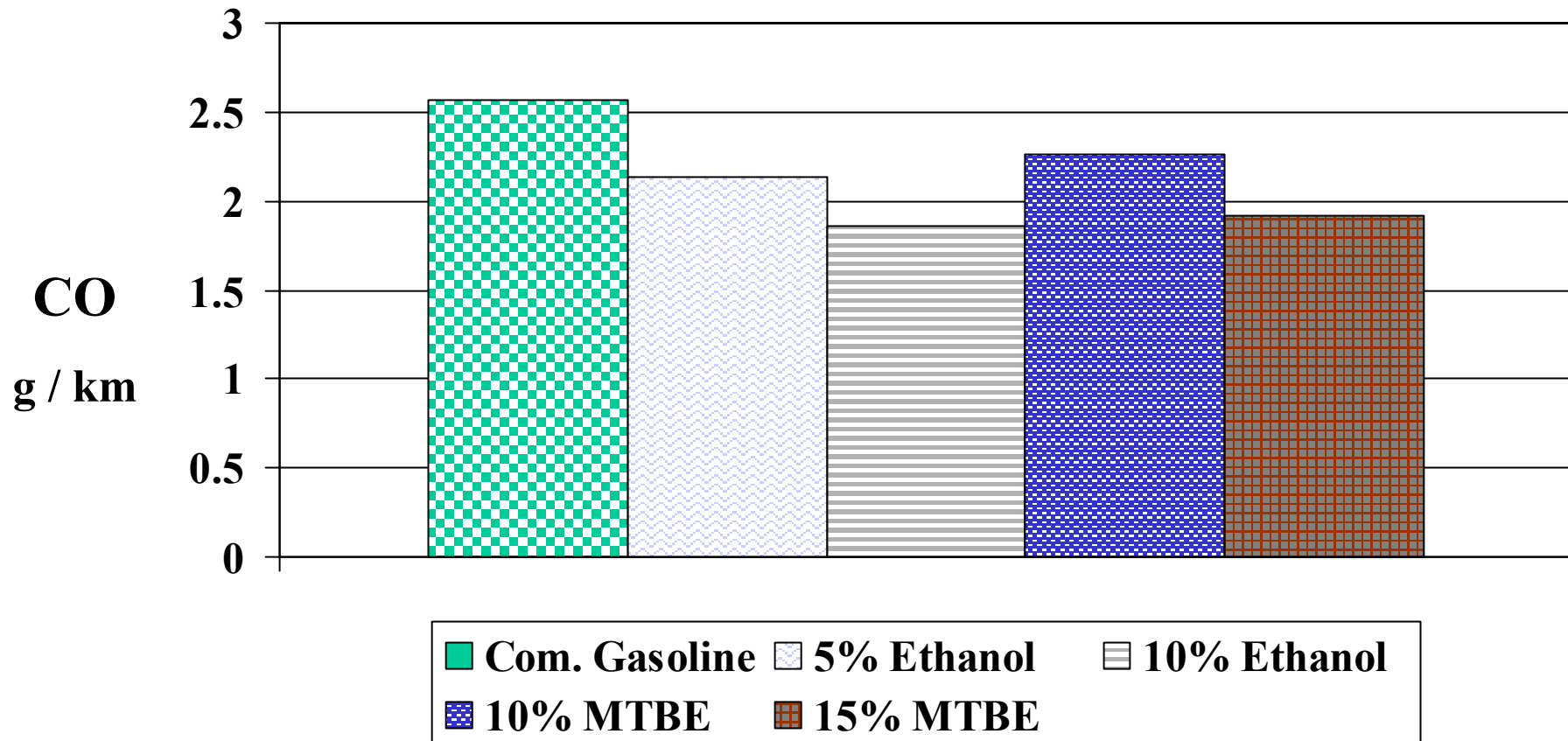
- **2-Stroke engines are relatively less fuel sensitive**
 - **3 - way catalyst is not used**
 - **OBD and oxygen sensors not used**
- **2-Stroke engines with catalysts require lead free and low Sulphur gasoline.**
- **Reduction of Benzene is important for emission control from 2 Stroke engines as HC exhaust emissions are higher.**

ROLE OF FUEL IN EMISSION CONTROL FROM 2 STROKE VEHICLES

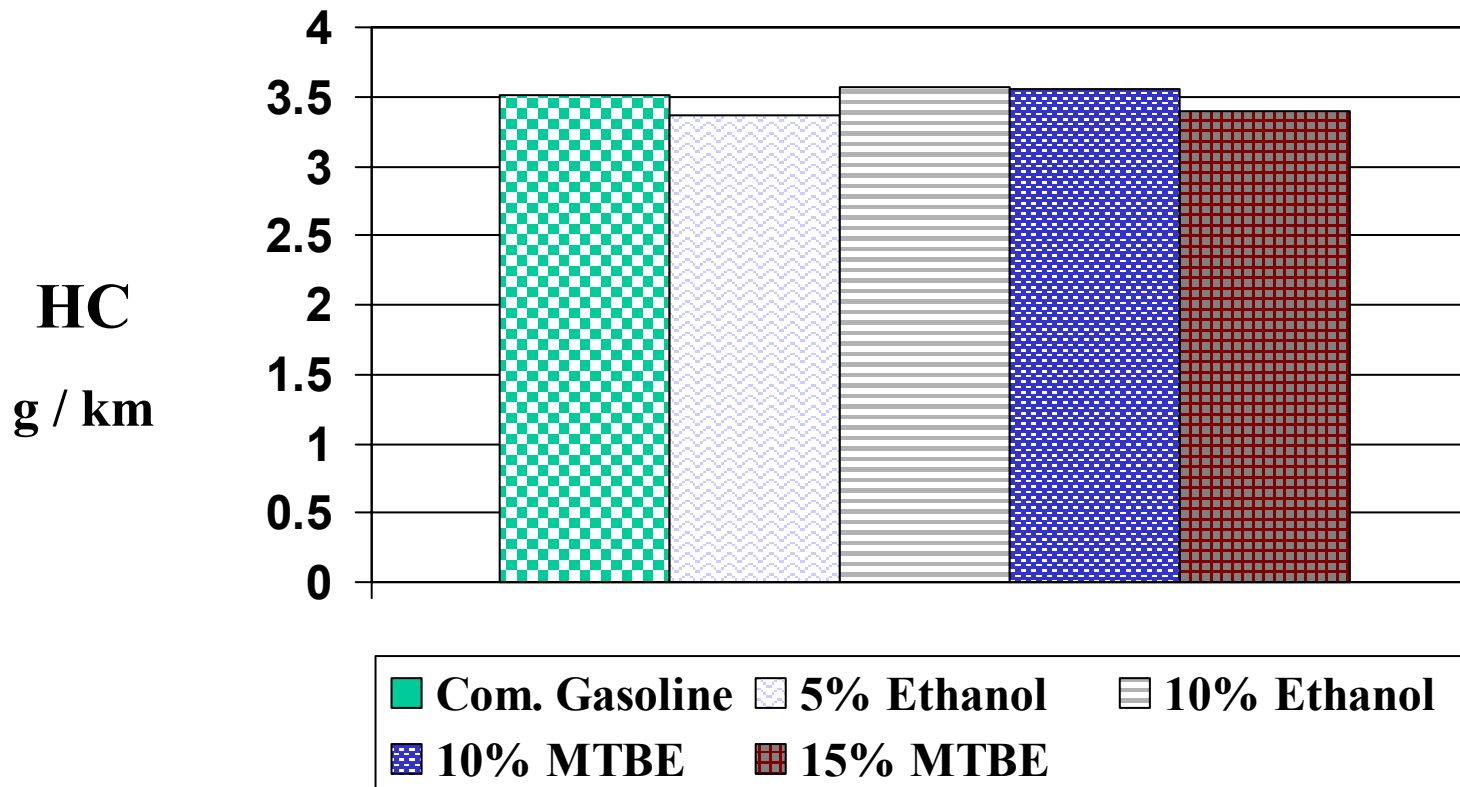
STUDIES CONDUCTED AT IOC R&D

- ROLE OF OXYGENATES LIKE ETHANOL, METHANOL, MTBE ETC.
- EFFECT OF OXYGENATED FUEL ON CATALYST PERFORMANCE
- ROLE OF MULTIFUNCTIONAL ADDITIVE (CURRENTLY BEING STUDIED)

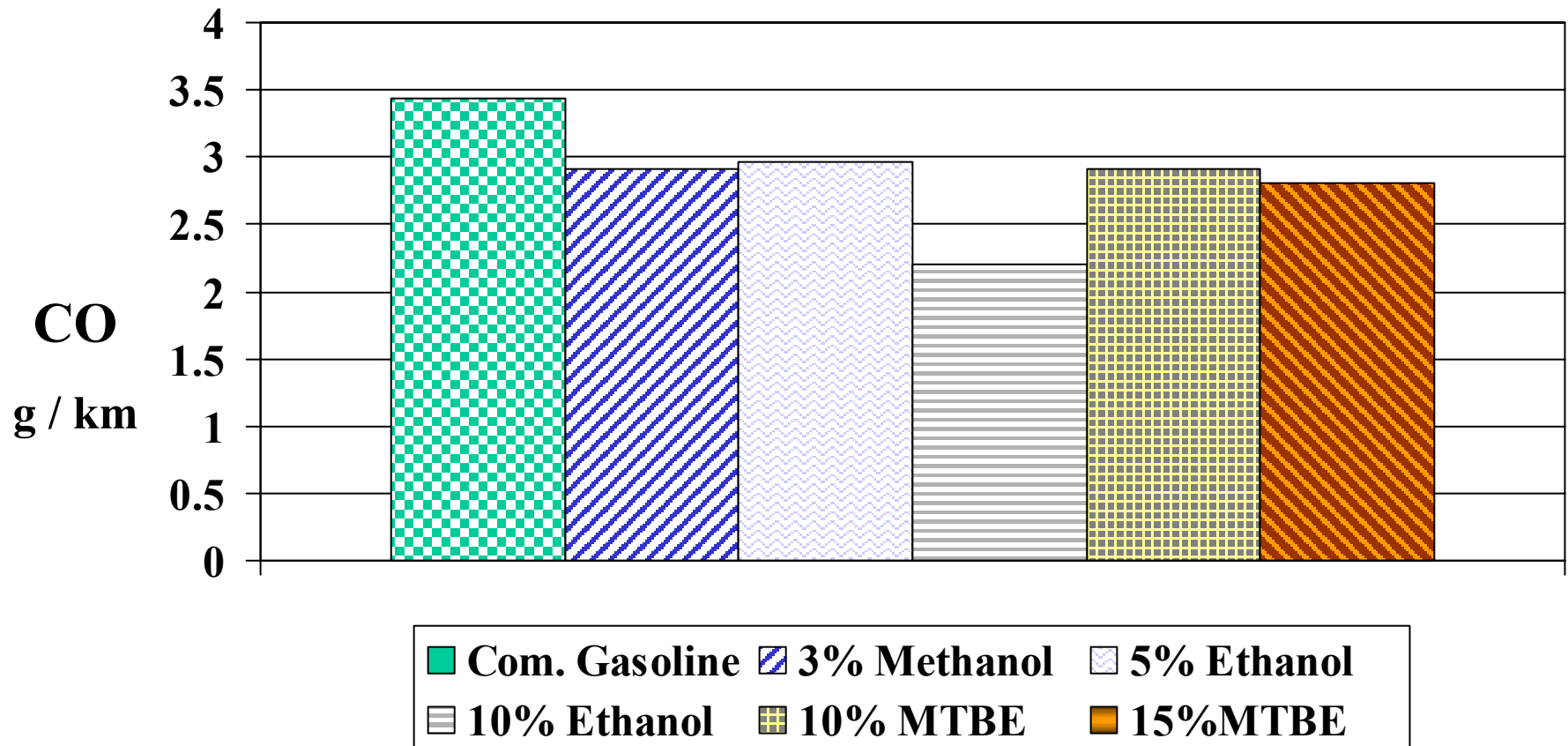
CO EMISSION WITH OXYGENATED BLENDS IN 150 CC SCOOTER



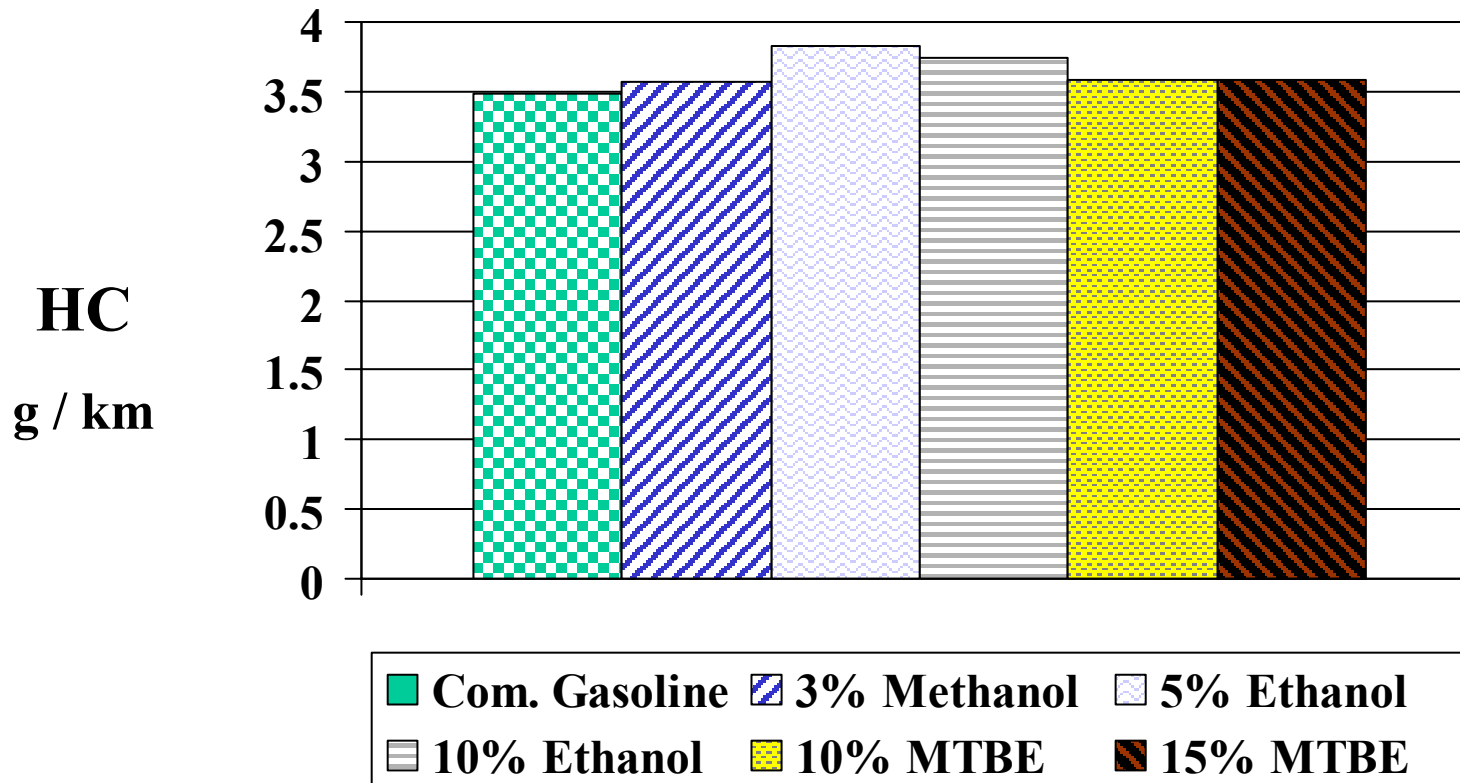
HC EMISSION WITH OXYGENATED BLENDS IN 150 CC SCOOTER



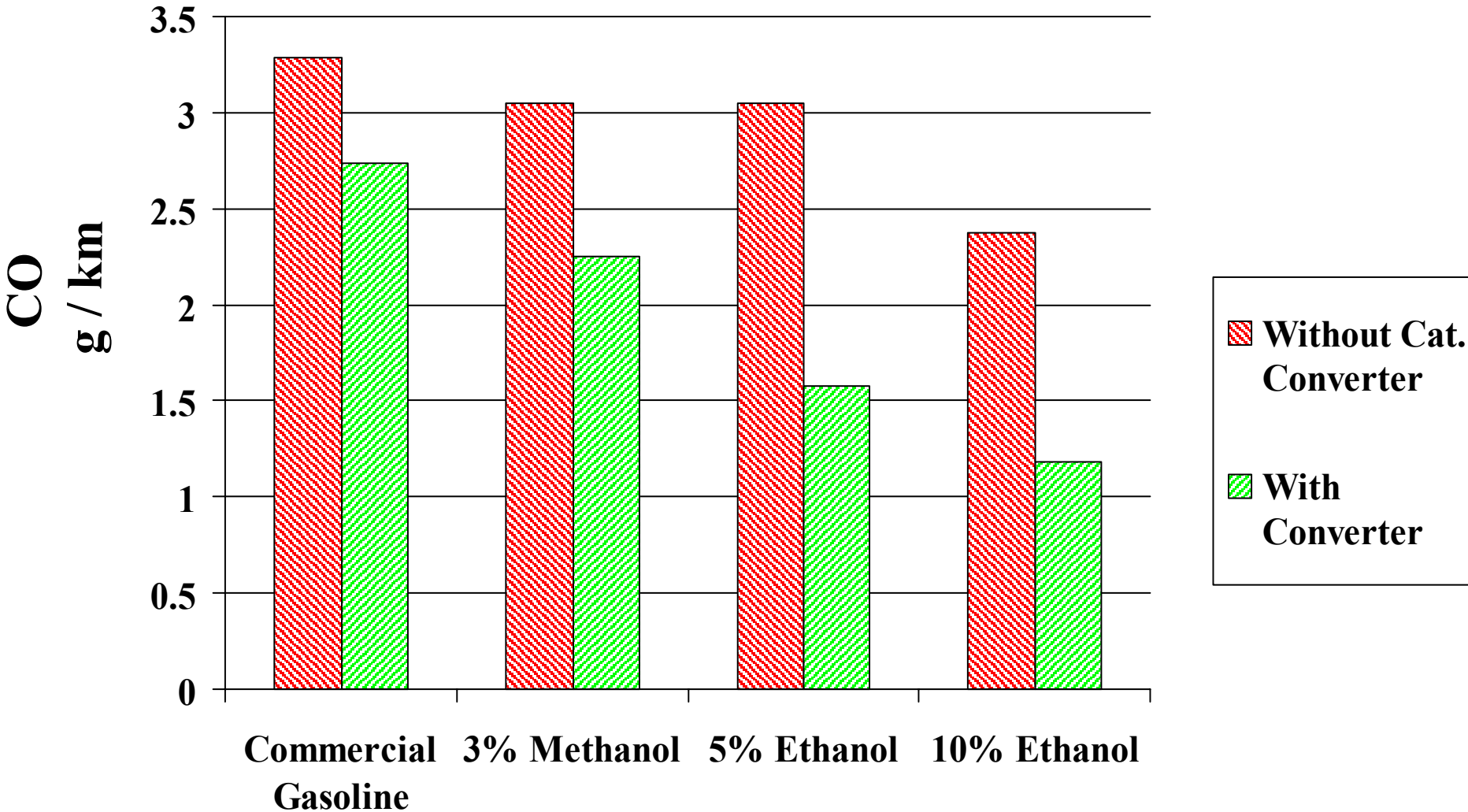
CO EMISSION WITH OXYGENATED BLENDS IN 75 CC SCOOTER



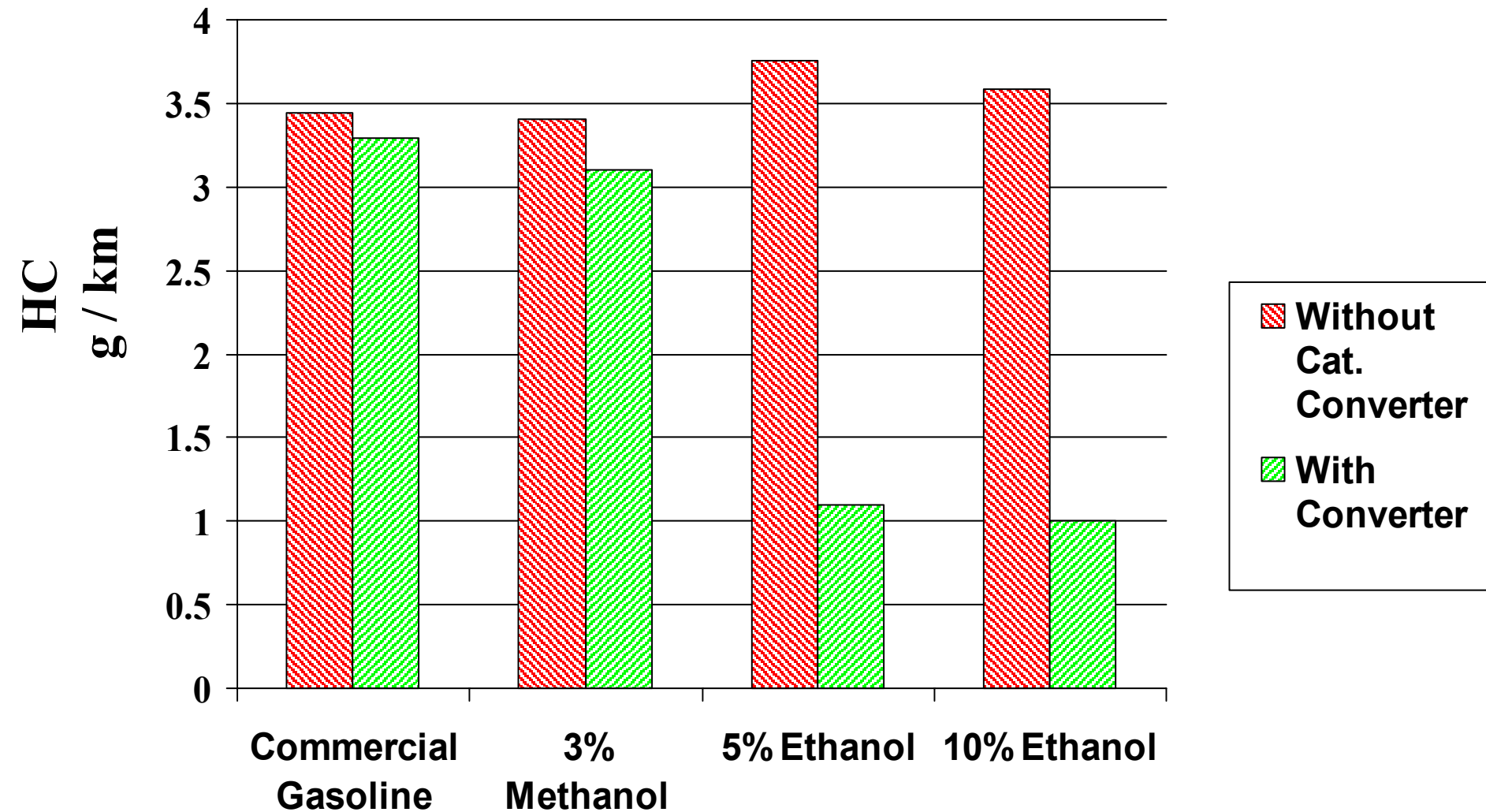
HC EMISSION WITH OXYGENATED BLENDS IN 75 CC SCOOTER



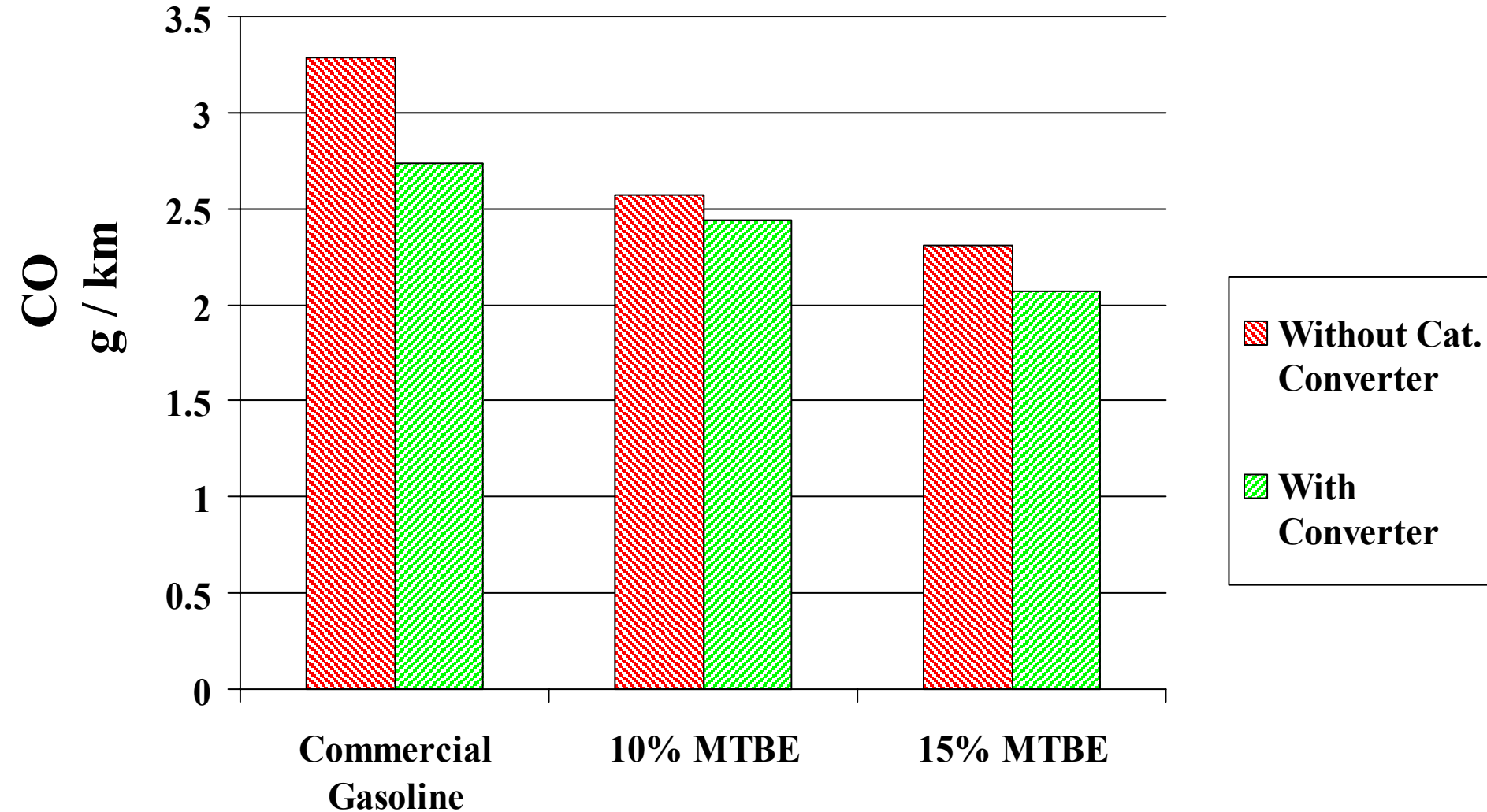
CO EMISSIONS WITH & WITHOUT CATALYTIC CONVERTER WITH DIFFERENT ALCOHOL BLENDS IN MOPED



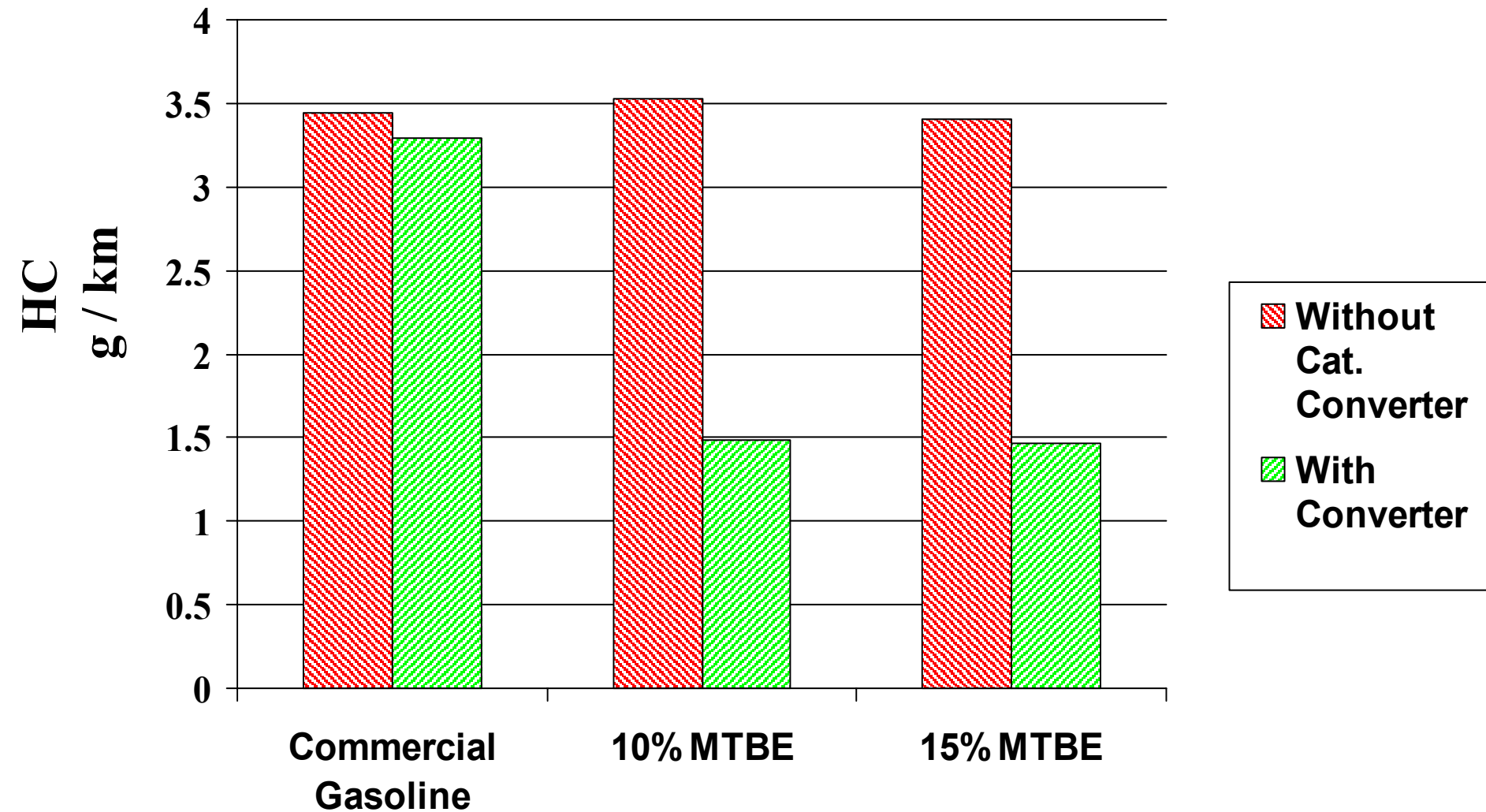
HC EMISSIONS WITH & WITHOUT CATALYTIC CONVERTER WITH DIFFERENT ALCOHOL BLENDS IN MOPED



CO EMISSIONS WITH & WITHOUT CATALYTIC CONVERTER WITH MTBE BLENDS IN MOPED



HC EMISSIONS WITH & WITHOUT CATALYTIC CONVERTER WITH MTBE BLENDS IN MOPED



ROLE OF LUBRICANT IN EMISSION CONTROL FROM 2 STROKE ENGINES

- Lubrication in 2 stroke engines is either through petroil (oil fuel mixing while dispensing) or through auto lube system (separate oil pump in vehicle).
- Use of higher dosage of oil leads to higher smoke, particulate and excessive engine deposits.
- Auto mixing of oil & fuel at dispensing stations help in controlling use of higher oil dosage

2 STROKE ENGINE OIL SPECIFICATIONS

EGE

Low Smoke
Higher lubricity
requirement

EGD

Low smoke
Higher detergency
requirement

EGC

Low smoke

EGB

TC

FC

Pass

Low smoke

Low smoke

TA/TB

FB

FA

API

JASO

TISI

ISO

EMISSION REGULATIONS AND LUBRICANT QUALITY

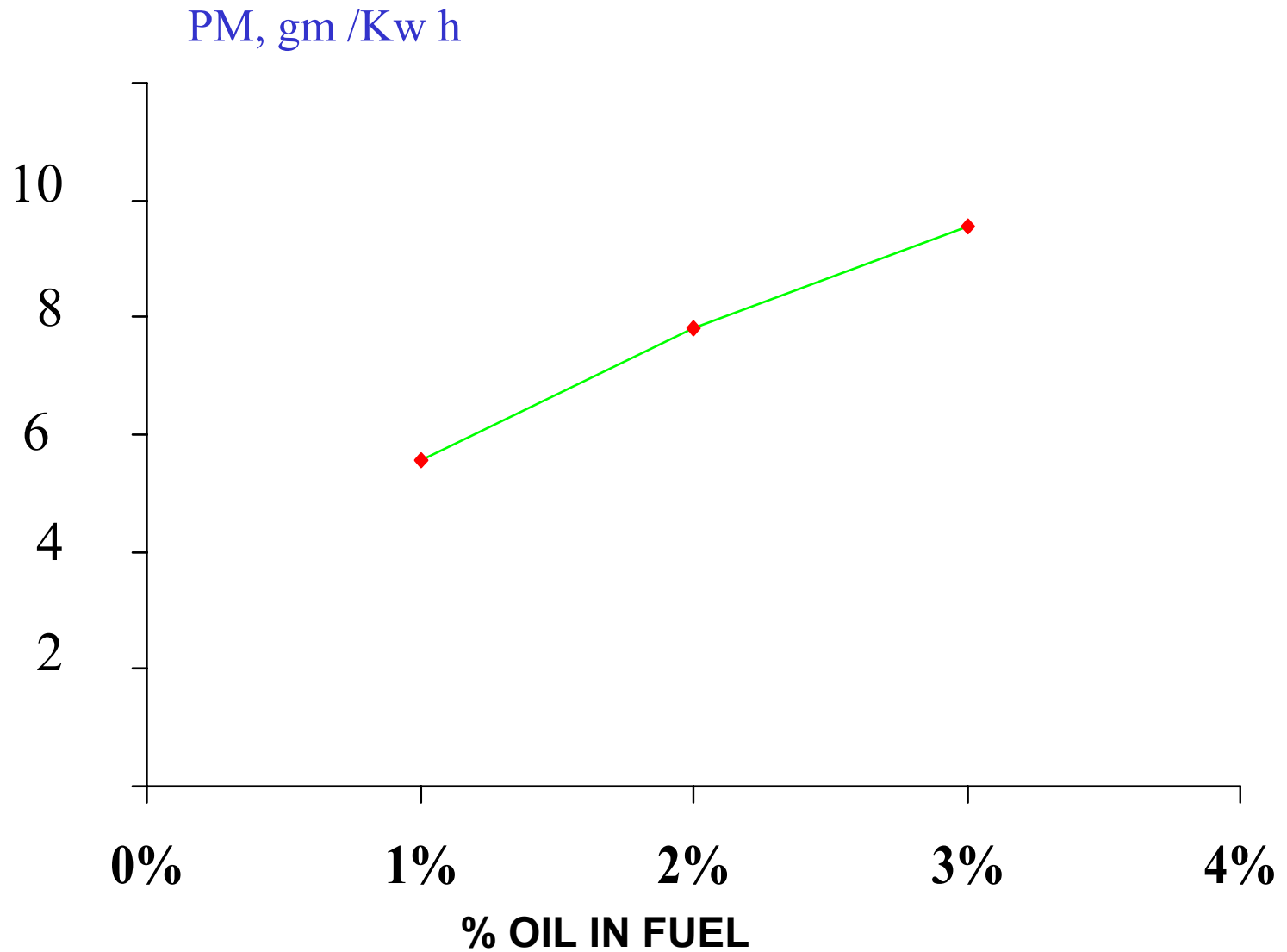
- **Exhaust Emission Durability**
 - **Improved Piston and Port Deposit Control**
 - **Improved Exhaust Blocking for scavenging efficiency**
 - **Lower Smoke**
- **Engine Oil Compatibility with Catalyst**
 - **Lower Ash? Max 0.1 mass % ?**
 - **JASO Ash Limit** : **Max 0.25 mass %**
 - **Proposed ISO EGD** : **Max 0.18 mass %**
 - **Japanese OEM Genuine Oils** : **Around 0.1 mass %**

ACTIONS TAKEN IN INDIA FOR EMISSION CONTROL FROM 2 STROKE ENGINES

- **Supply of pre-mixed fuel oil mixtures through retail outlets**
- **Ban on supply of loose 2 – T oils at petrol stations**
- **Notification by Ministry of Environment and Forest under Environment Protection Act specifying JASO – FC grade**
- **Development of high performance oils which allow low oil – fuel ratios**

DEVELOPMENT OF HIGH PERFORMANCE LOW OIL – FUEL RATIO 2-T OIL

- **Indian Oil Corporation has developed a new generation 2-T oil which can be used at 50% low treat level as compared to conventional 2-T oils.**
- **Performance features of the new oil developed**
 - **Excellent lubricity**
 - **Detergency**
 - **Low smoke**
 - **Anti scuffing characteristics**



**PARTICULATE MATTER vs. OIL CONCENTRATION
IN FUEL, 2 STROKE ENGINE (REF. SAE 911222)**

SMOKE, % OPACITY AT 50 KPH, FULL THROTTLE ON CHASSIS DYNAMOMETER

Conventional API-TC Oil		New Generation 2-T Oil		
2%	4%	1%	2%	3%
57	79	25	36	46

PERFORMANCE OF NEW GENERATION LOW OIL-FUEL RATIO 2-T OIL

- Excellent results in engine tests as per JASO-FC specification**
- Field tests, seizure tests and service trials have all shown excellent performance**
- Use of new oil results in reduction of visible smoke and particulates**
- However, no significant effect was observed in case of gaseous emissions of CO & HC.**
- Less deposits on engine components and exhaust system**
- Improved catalytic converter efficiency and longer life of catalyst**

CONCLUSIONS

- Use of oxygenates in gasoline resulted in reduction of carbon monoxide emissions from 2 stroke engines while no significant change was observed in hydrocarbons.
- For catalytic converter fitted vehicles, the use of oxygenated fuel resulted in significant reduction of carbon monoxide and hydrocarbons due to improved efficiency of converter.

CONCLUSIONS (contd)

- Low oil fuel ratio in 2 stroke engines result in lower smoke and particulate emissions.
- Superior quality 2T oils like JASO FC can reduce smoke emissions.
- New generation 2T oil developed by Indian Oil can be used at half of the conventional oil dosage. This oil results in lower smoke, particulates and reduced deposits besides longer life of catalyst.

ACKNOWLEDGEMENT

- **I would like to acknowledge my thanks to Dr. A.K.Bhatnagar, Director R&D, IOC for allowing me to make this presentation in this Workshop and to Mr.N.R.Raje, GM, IOC for valuable advice.**
- **Thanks are also due to my colleagues – Mr.A.K.Misra, Dr.A.M.Rao, Dr.S.Nandi, Mr.G.K.Acharya, Mr.M.Maheshwari and Mr.N.K.Pal for their kind help**

THANK YOU

**e-mail : malhotrark@iocrnd.stpn.soft.net
rkmioc@hotmail.com**