

EXPORTING

Low Emission Diesel Engine Oils Conference

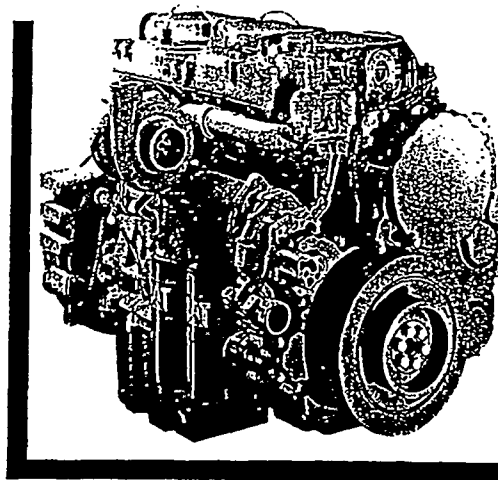
Sample Analytical Tools For Diesel Catalyst/Lube Oil Additive Studies



By Magdi Khair

January 30 - February 1, 2000

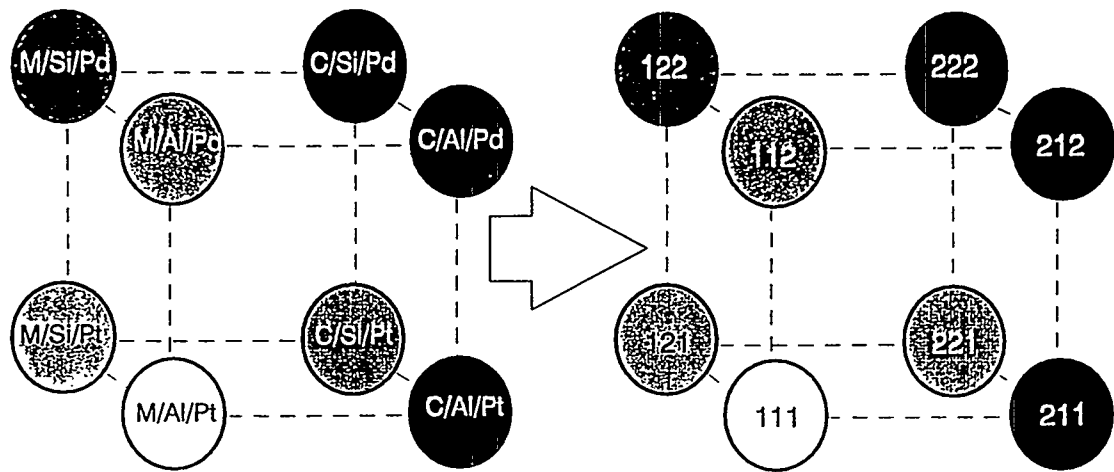
Potential Poisoning Effect Of Lubricating Oil On Diesel Catalytic Converters



Catalyst Description

Catalyst Detail

Catalyst Designation



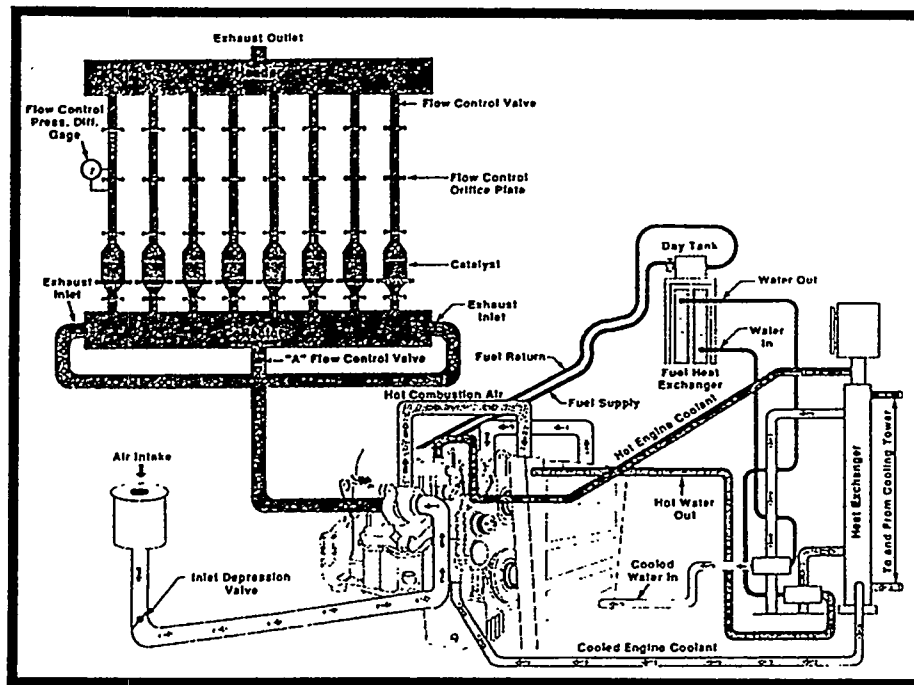
Lube Oil Description

Content	Baseline	Additized
Mn	<1	<1
Mg	8	8
Fe	1	1
Cr	<1	<1
Cu	<1	<1
B	<1	<1
Ba	<1	<1
Ag	<1	<1
Al	1	1
Zn	1248	5166
Sn	1	<1
Si	<1	2
Sb	<1	<1
P	1147	4592
Pb	<1	3
Ni	1	<1
Mo	<1	<1
S	0.39	1.063
Ca	2061	1956
K. Vis. 100 cST.	14.28	13.79
K. Vis., 40 cST.	99.57	96.95
ASH, ASTM D-482, wt%	0.78	2.03
ASH, ASTM D-482, wt%	0.88	2.06

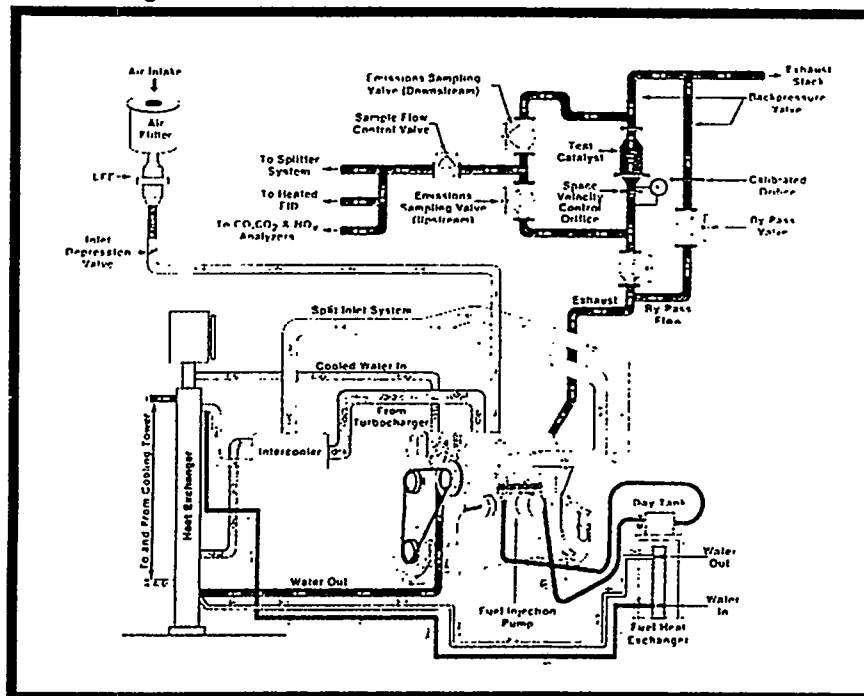
Units in ppm unless otherwise noted



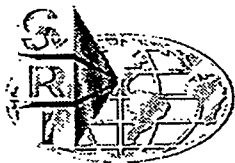
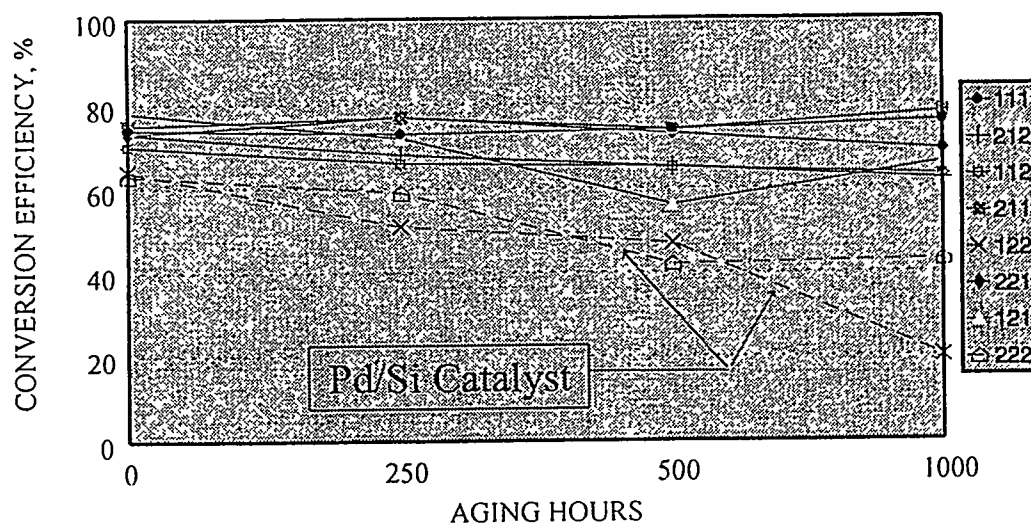
Catalytic Converters Aging



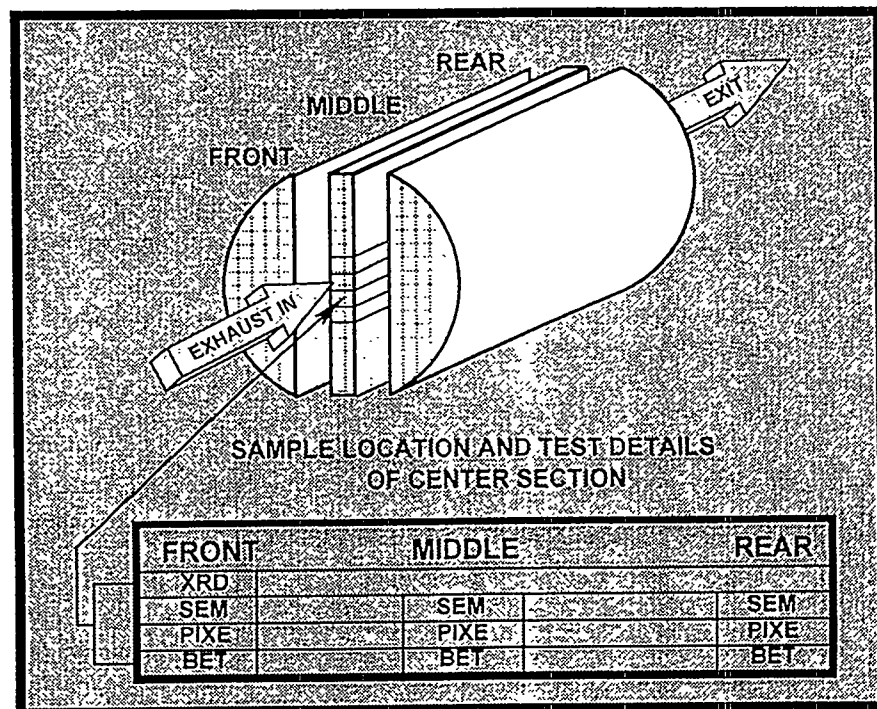
Catalytic Converters Assessment



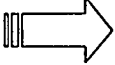
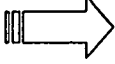
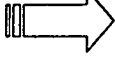


Sample Result For HC Conversion



Catalytic Converters Preparation

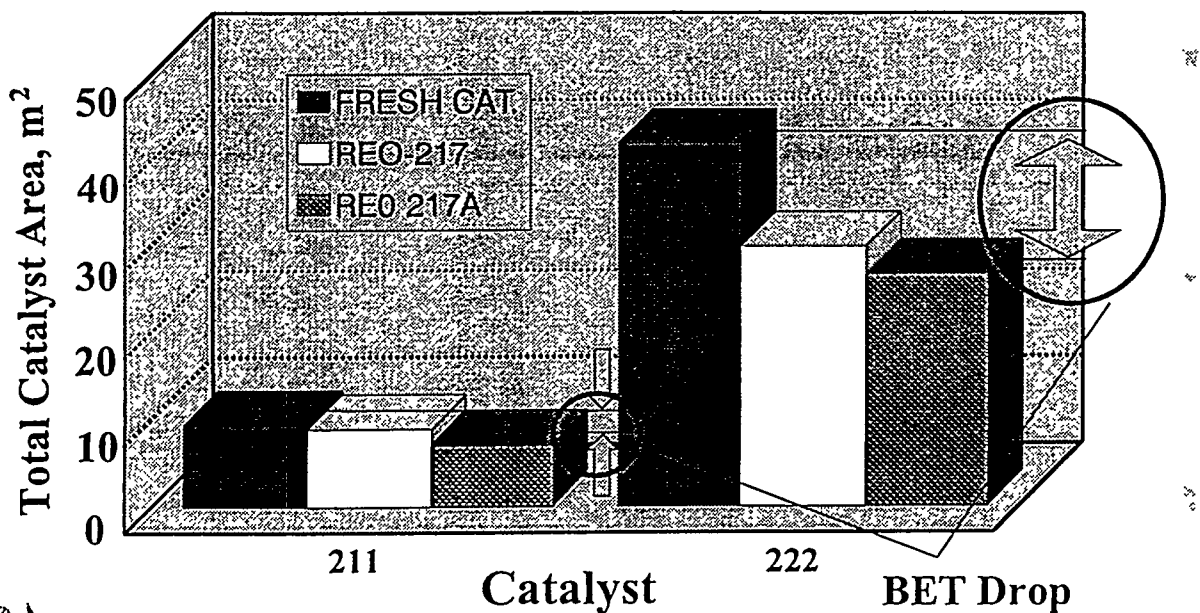


Analytical Methods

BET		Brunauer-Emmett-Teller	(Surface Area/Unit Mass)
SEM		Scanning Electron Microscope	(Determine Topographical Features of Catalyst Surface)
PIXE		Proton-Induced X-ray Emission	(Determine Presence of Noble Metal & Poisons)
XRD		X-ray Diffraction	(Determine Changes in Washcoat Crystalline Structure)
EDX		Energy Dispersive X-ray	(Determine Spectrum of Surface Elements)

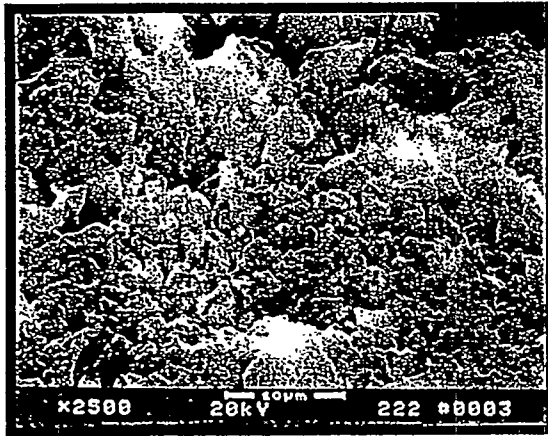


Catalytic Converters Assessment (BET Surface Area Drop For Two Catalyst Formulations)

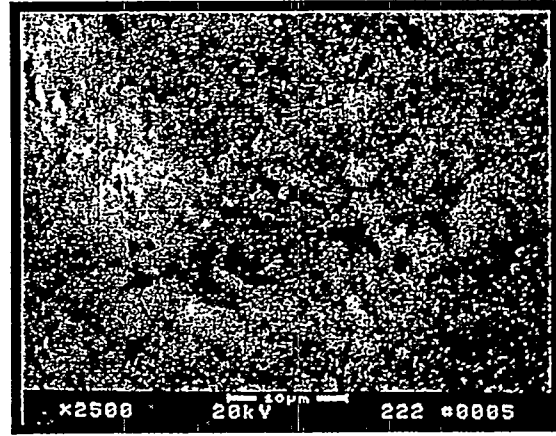


Catalytic Converters Assessment

(Amplified SEM Photographs)



Fresh



Aged
(1K Hrs.-Add. Lube)

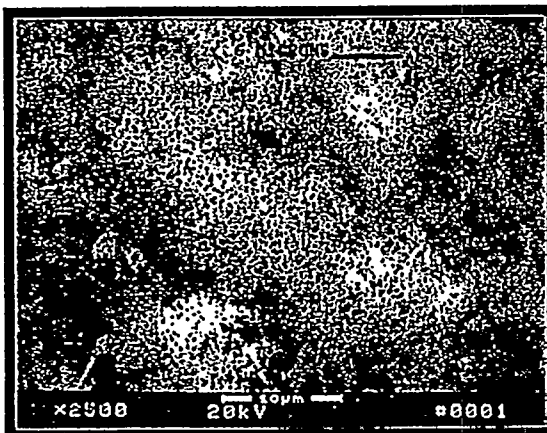
222-Front



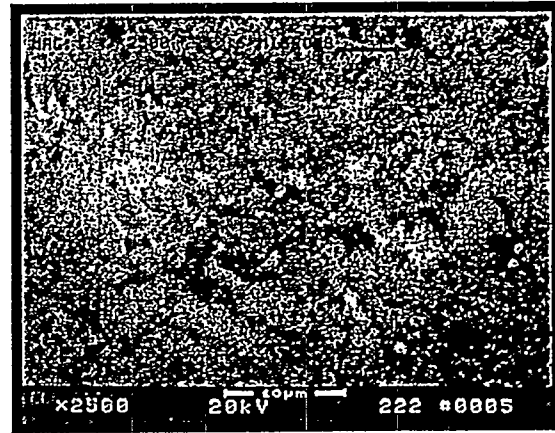
Catalytic Converters Assessment

(Amplified SEM Photographs - Sulfur Distribution By EDX)

Front



Regular Lube



Additized Lube

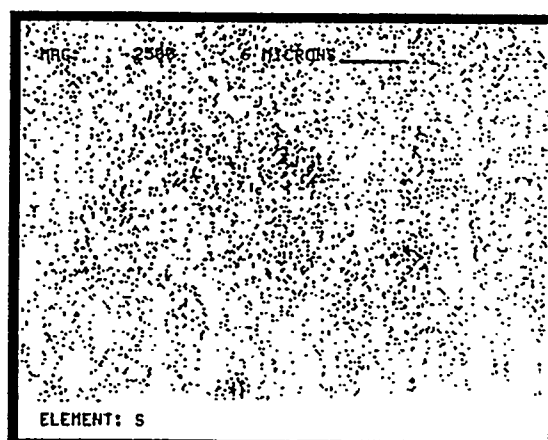
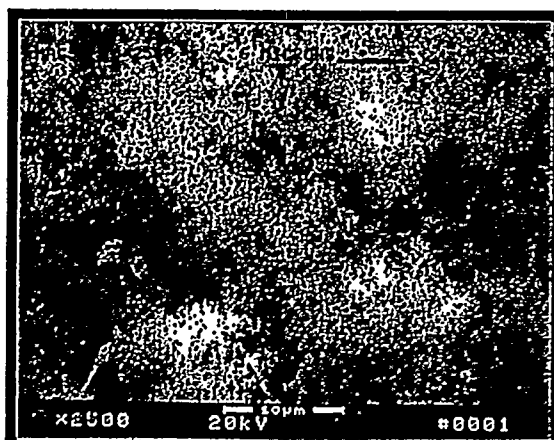
222 Aged For 1000 Hours



Catalytic Converters Assessment

(Amplified SEM Photograph - Sulfur Distribution By EDX)

Front



Regular Lube

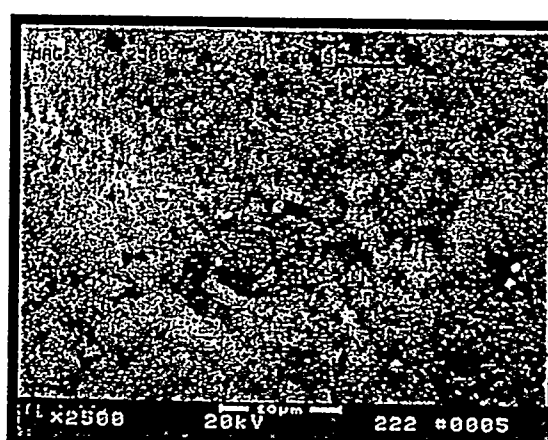
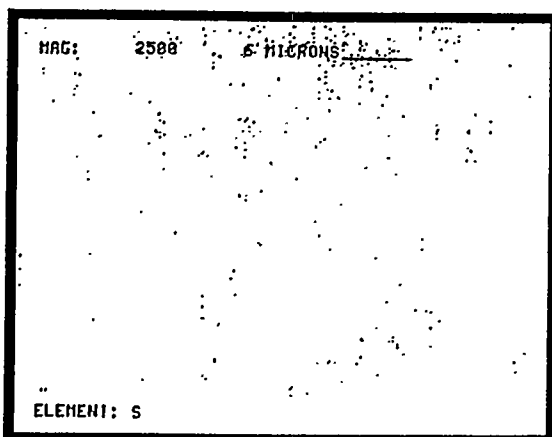


222 Aged For 1000 Hours

Catalytic Converters Assessment

(Amplified SEM Photograph - Sulfur Distribution By EDX)

Front



Additized Lube

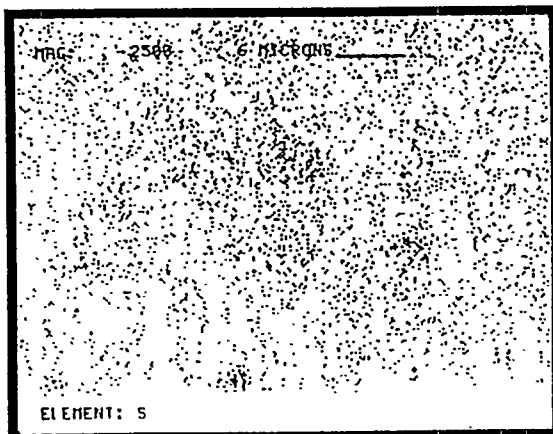


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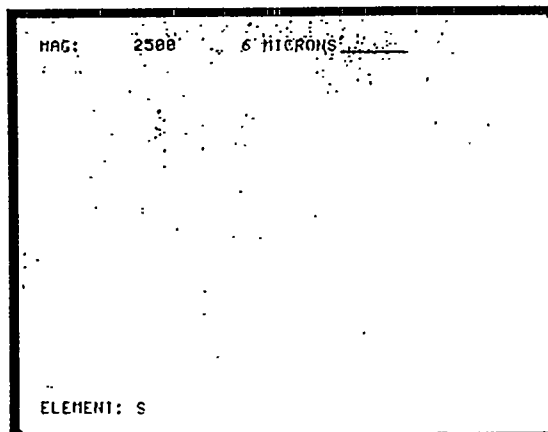
Catalytic Converters Assessment

(Sulfur Distribution By EDX)

Front



Regular Lube



Additized Lube

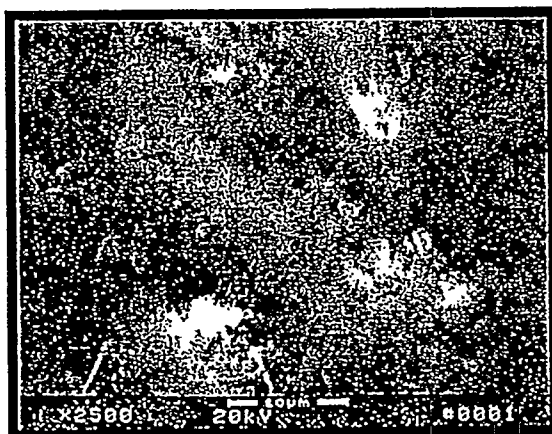


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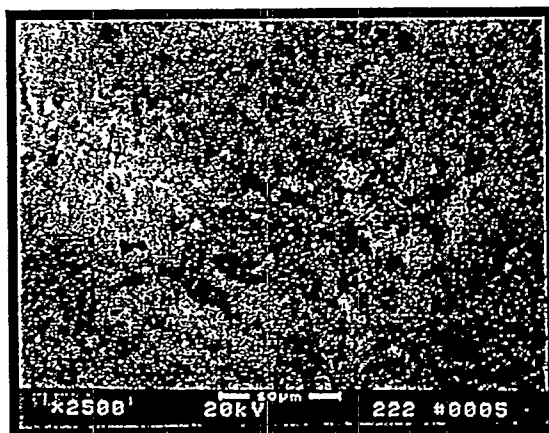
Catalytic Converters Assessment

(Amplified SEM Photographs - Phosphorous Distribution By EDX)

Front



Regular Lube



Additized Lube

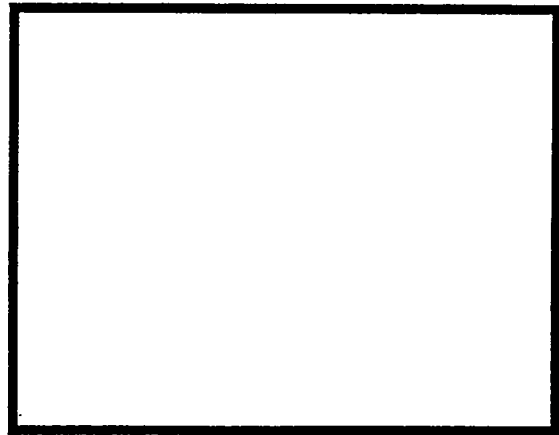
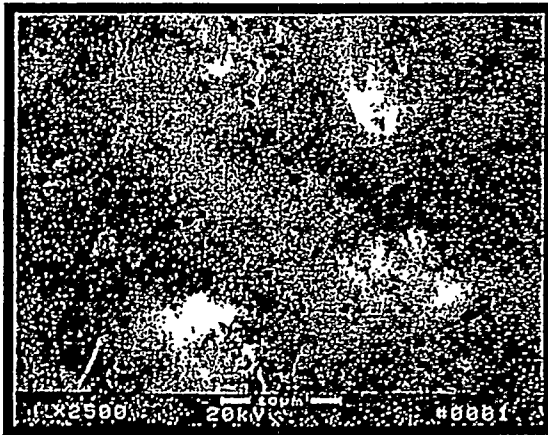


222 Aged For 1000 Hours

Catalytic Converters Assessment

(Amplified SEM Photograph - Phosphorous Distribution By EDX)

Front



Regular Lube

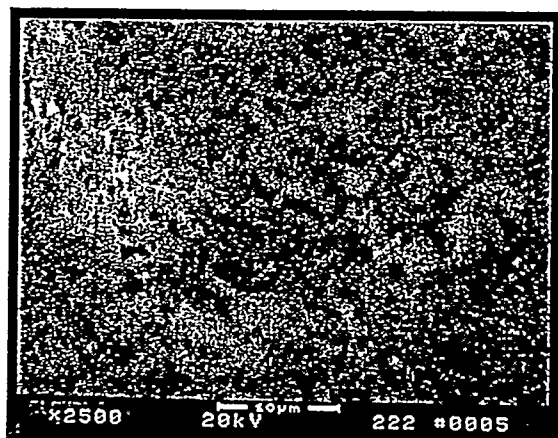
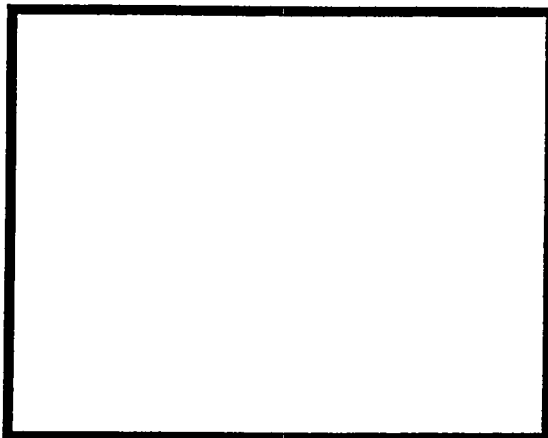
222 Aged For 1000 Hours



Catalytic Converters Assessment

(Amplified SEM Photograph - Phosphorous Distribution By EDX)

Front



Additized Lube

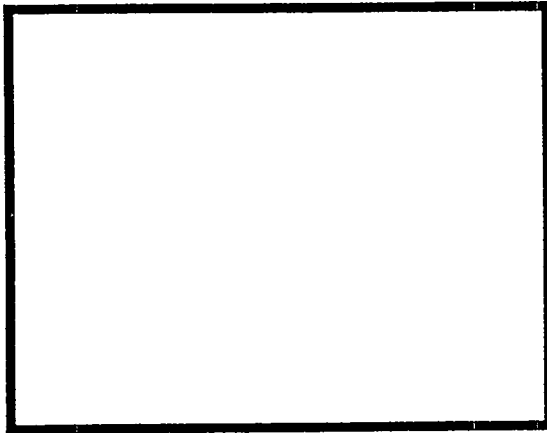
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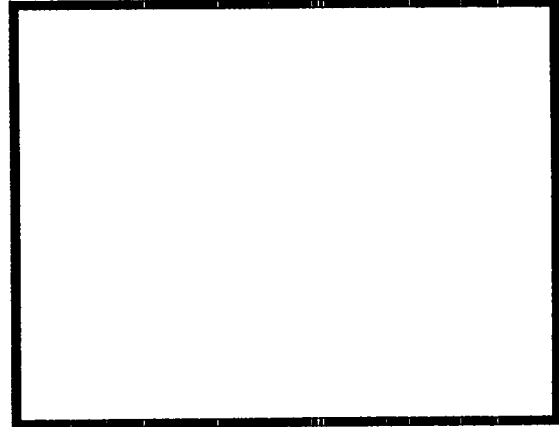
Catalytic Converters Assessment

(Amplified SEM Photographs - Phosphorous Distribution By EDX)

Front



Regular Lube



Additized Lube

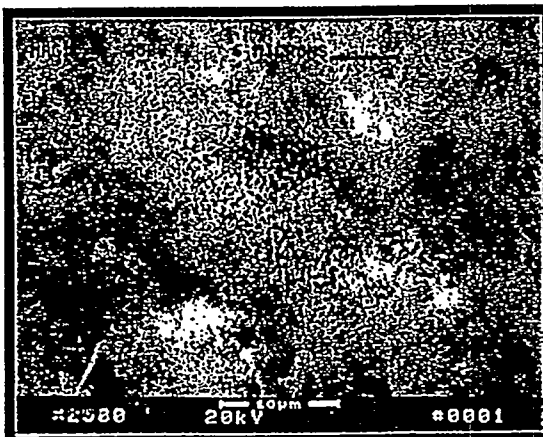


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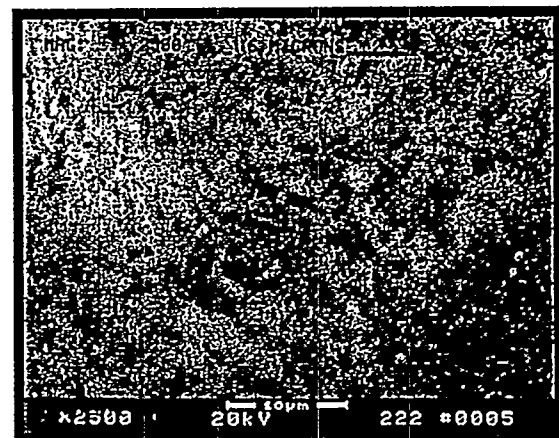
Catalytic Converters Assessment

(Amplified SEM Photographs - Zinc Distribution By EDX)

Front



Regular Lube



Additized Lube

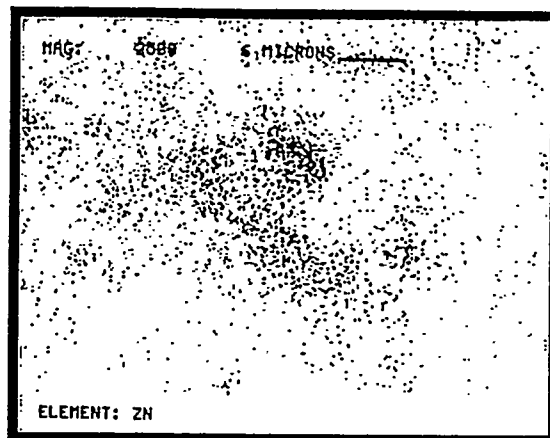
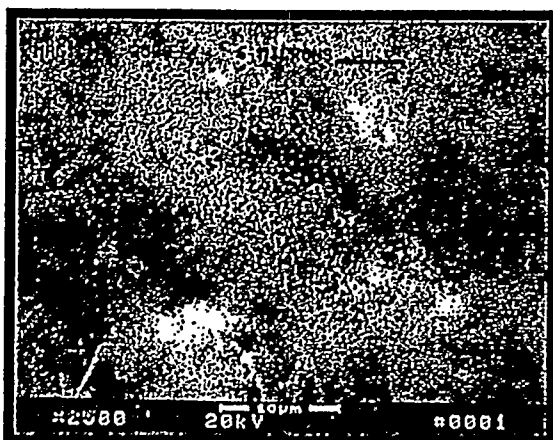


222 Aged For 1000 Hours

Catalytic Converters Assessment

(Amplified SEM Photograph - Zinc Distribution By EDX)

Front



Regular Lube

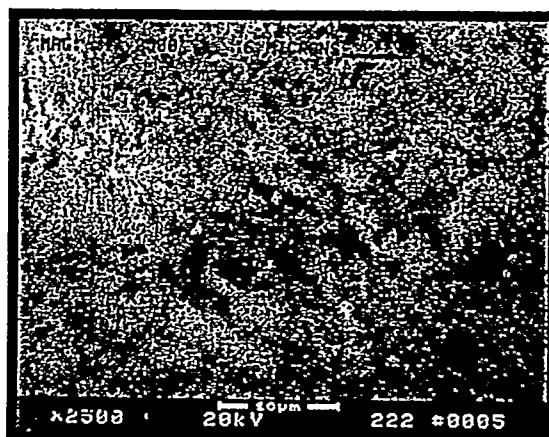
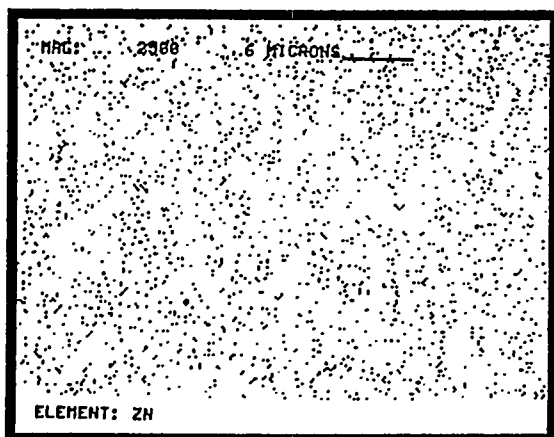
222 Aged For 1000 Hours



Catalytic Converters Assessment

(Amplified SEM Photograph - Zinc Distribution By EDX)

Front



Additized Lube

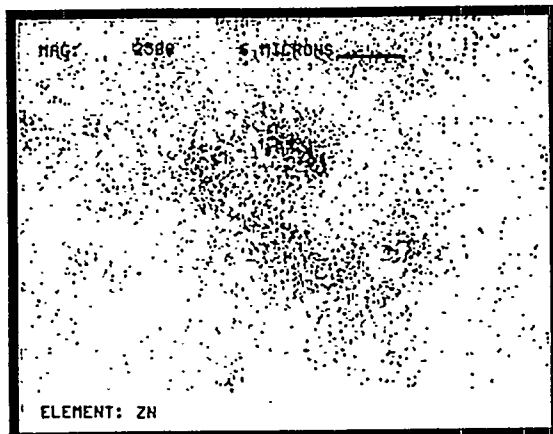
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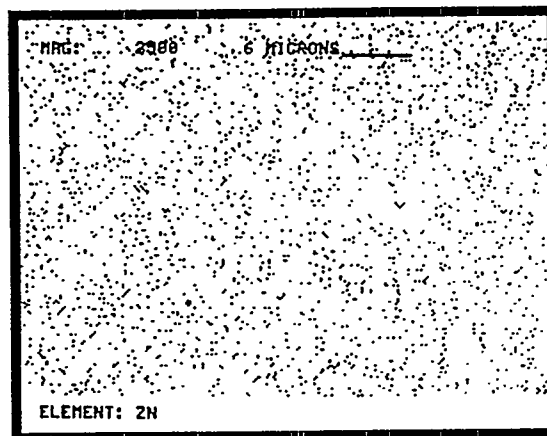
Catalytic Converters Assessment

(Amplified SEM Photographs - Zinc Distribution By EDX)

Front



Regular Lube



Additized Lube

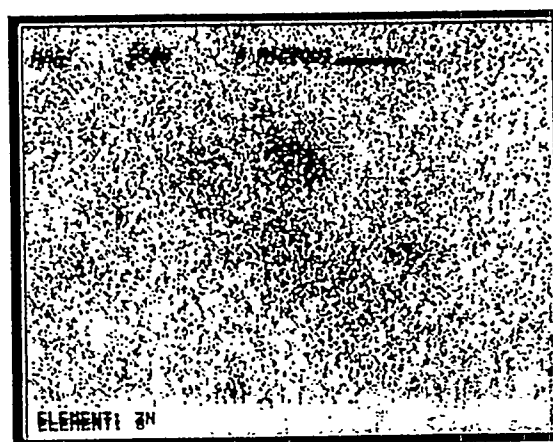


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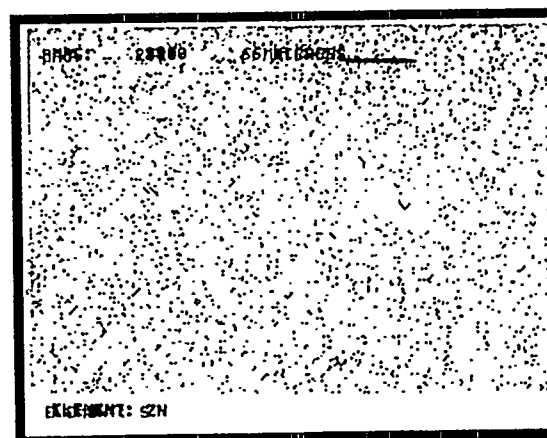
Catalytic Converters Assessment

(Sulfur/Phosphorous/Zink Distribution By EDX)

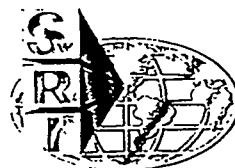
Front



Regular Lube



Additized Lube

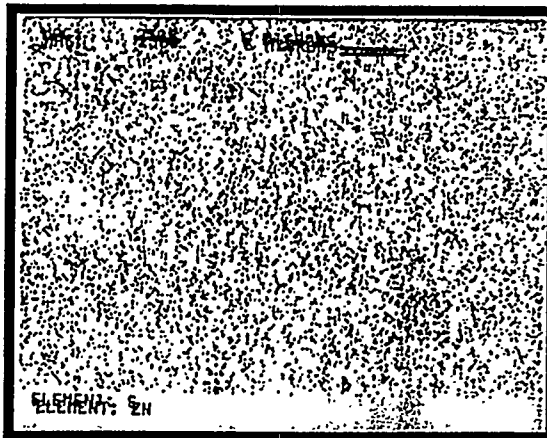


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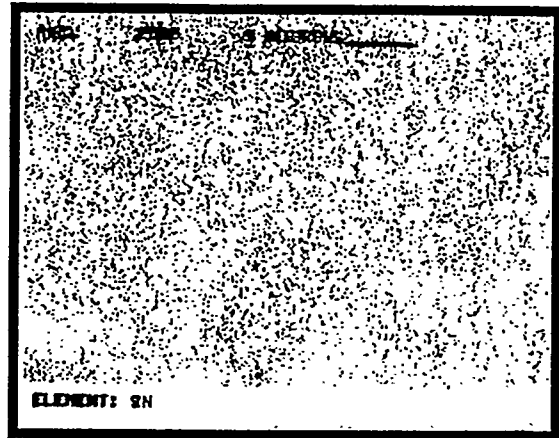
Catalytic Converters Assessment

(Sulfur/Phosphorous/Zink Distribution By EDX)

Front



Regular Lube



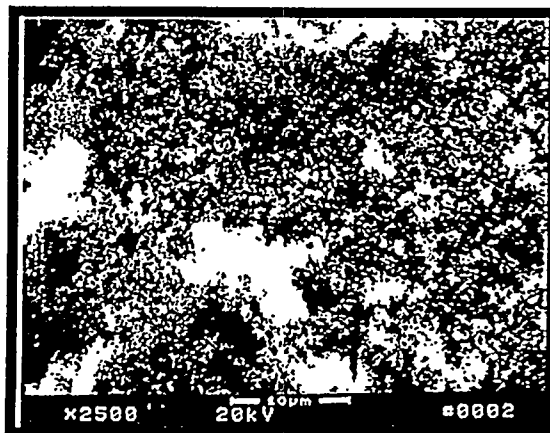
Additized Lube

211 Aged For 1000 Hours

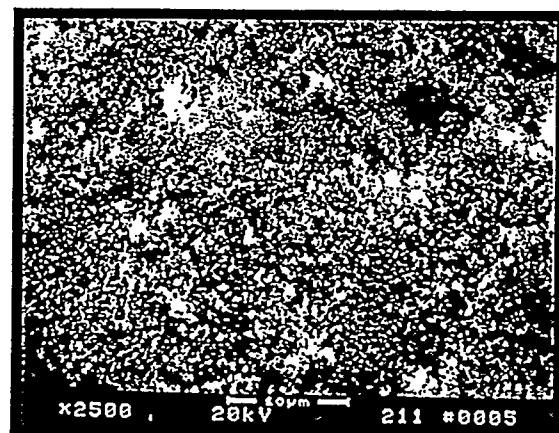


Catalytic Converters Assessment

(Amplified SEM Photographs)



Fresh



Aged

(1K Hrs.-Add. Lube)

211-Front



Concluding Comments

- Several analytical tools are available to study the interactions between catalyst and lube oil formulation
- Careful attention is advised when interpreting results of any of these analytical methods.
- Analysis of the catalyst front face may lead to different conclusions than the middle or the rear of the catalyst.
- Impact of sulfur should be viewed in light of effect of other elements in lube oil package such as phosphorus and especially, zinc.

