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DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Refuse incineration slag treatment in the Hamburg-Borsigstrasse refuse
incineration plant, GermanyCA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL
SOCIETY

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2/6/201 (Item 77 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Method for preventing lowering of fluidity of molten slag in plasma
melting furnace for treatment of municipal refuse incineration ash.
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/202 (Item 78 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Separation of pollutants from waste gases from municipal incinerators
using furnace ash and/or slag
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/203 (Item 79 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Process for separation of copper and heavy metals from incinerated
garbage residue and slag
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/204 (Item 80 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Actual data report of residue and fly ash melting, and slag recovery in
the MSW incineration plant
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/206 (Item 82 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Behavior of slag derived from DIS (special industrial wastes) and used
for road building. Comparison with slag from incineration of domestic waste
(OM)
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/207 (Item 83 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Modification of steelmaking slag by utilization of noncombustibles in
city garbage
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/208 (Item 84 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Serial batch tests performed on municipal solid waste incineration bottom
ash and electric arc furnace slag, in combination with computer modeling
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/209 (Item 85 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Melting of incinerator ash and fly ash in slag discharge type rotary kiln
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/210 (Item 86 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Coloring of molten slag from garbage incineration
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/211 (Item 87 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Heat-treating process for combustible material-containing waste solids
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/212 (Item 88 from file: 399)DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL
SOCIETY. All rts. reserv.
Molten slag from municipal refuse for pavement
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/213 (Item 89 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Processing slag from incineration of municipal wastes
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/214 (Item 90 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Processing of municipal and other wastes in molten slag bath
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/215 (Item 91 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Treatment process for residues in refuse incinerator plants
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/216 (Item 92 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Incinerator flue gas cleaning with milled slag sorbents
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/217     (Item 93 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
The influence of combustion bed temperature during waste incineration on
slag quality
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/218     (Item 94 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Fusion of slags by the HSR process
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/219     (Item 95 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Logistics and management of mechanical slag beneficiation
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/220     (Item 96 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Slag processing and utilization by an association for disposal and use of
waste (GfA) in the Geiselbullach waste incinerator power plant (Germany)
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/222     (Item 98 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Mechanical slag beneficiation technologies and mechanical equipment of
the system KHD Humboldt Wedag AG
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/223     (Item 99 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Slag beneficiation through aging and leaching
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/224     (Item 100 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
DBA-roller grate-direct current firing for optimization of slag qualityCA SEARCH(R)
1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/225     (Item 101 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Criteria and acceptance questions for slag utilization in Switzerland
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/226     (Item 102 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Quantity, quality, and utilization possibilities of waste incinerator
slags - general review
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/227     (Item 103 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
VS Combi reactor of Kuepat AG firm for melting of wastes and combustion
residues
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/228     (Item 104 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
A study on the behavior of PCDDs/DFs in a municipal refuse fly-ash
melting experiment
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/229     (Item 105 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Vitrification of slags and dusts (from refuse incinerators)
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/230     (Item 106 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Statistical analyses of control parameters for physicochemical properties
of solidified incinerator fly ash of municipal solid wastes
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/232     (Item 108 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Study on transformation of Cr6+ in codisposal of chromium slag and
domestic garbage
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/233     (Item 109 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Manufacture of melting slag from incinerator ashes from municipal refuse
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
=============================================
2/6/234     (Item 110 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Manufacture of high grade materials from molten slag and low temperature
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sintered articles therefrom
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/237 (Item 113 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Melting process of ash from municipal incinerators by plasma arc heating
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/238 (Item 114 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Development of an MSW ash melting system of low running cost
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/239 (Item 115 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Ecologically clean technology for processing of municipal wastes in a
Vanyukov furnace
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/240 (Item 116 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
The presence and distribution of heavy metals in municipal solid waste
incinerators
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/241 (Item 117 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Melting furnaces for waste solid treatment
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/242 (Item 118 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Recovery of vanadium pentoxide by chlorination in hydrochloric acid
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/243 (Item 119 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Utilization of refuse incineration slags after conventional processing.
Part 1
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/244 (Item 120 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
The use of waste materials in civil engineering. AVI slag can replace
gravel in concrete production
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/245 (Item 121 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Wastes, combustion, and then? Qualitative and quantitative aspects of
residues from combustion plants
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/246 (Item 122 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Effect of additions of refuse-incineration-plant (MSZ) slag and a
plasticizer on cement structure
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/247 (Item 123 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Development of municipal solid waste (MSW) ash melting system of IHI
rotary stoker type incinerator
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/248 (Item 124 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.A method for
incineration of refuse
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/249 (Item 125 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Multielement analysis of city waste incineration ash and slag by
inductively coupled plasma atomic emission spectrometry
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/250 (Item 126 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Slag from refuse-incinerating plants for cement concretes
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/251 (Item 127 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Solidification materials for solid wastes and soils
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/252 (Item 128 from file: 399)

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DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Short-term release of slag and fly ash produced by incineration of
municipal solid waste
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/253     (Item 129 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Use of ash and slag from the processing of solid refuse
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/254     (Item 130 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Mortar containing municipal refuse incineration ash fused slag
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/255     (Item 131 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Concrete plates from municipal refuse incineration ash fused slag
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/256     (Item 132 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Process for removal of flue dust and/or slags from municiple refuse
incinerators
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/257     (Item 133 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Discharge control of fused slag of municipal incinerator ash
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/258     (Item 134 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Optimization of waste combustion plants with the goal of decreasing air
pollution
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/259     (Item 135 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Process for waste decomposition
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/260     (Item 136 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Emissions arising during the combustion of high calorific industrial
wastes in a municipal incineratorCA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN
CHEMICAL SOCIETY
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2/6/261     (Item 137 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Leaching behavior of residues from waste incineration plants.  2.
Exemplified by the Grossmehring refuse landfill
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/262     (Item 138 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Leaching behavior of residues from waste incinerators, as illustrated by
the Grossmehring landfill. (Part 1)
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/263     (Item 139 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Treatment of liquid wastes
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/264     (Item 140 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Structure of ceramics produced with slag from city solid refuse
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
==============================================
2/6/265     (Item 141 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Fusion and leaching of dust from waste incinerators
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/266     (Item 142 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Fertilizers from city garbage
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/267     (Item 143 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Melting of ashes
CA SEARCH(R)  1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY
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2/6/268     (Item 144 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
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Treatment of municipal waste leachate by granulated slag
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/269 (Item 145 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Molten iron bath incinerator for solid wastes
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/271 (Item 147 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Leaching of incinerator slag from municipal waste
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/273 (Item 149 from file: 399)DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Refractory tamping, spraying, and casting masses for coating slag-tap and cyclone furnaces of power plants and refuse incinerators
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/275 (Item 151 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Leaching experiments on the slag from refuse incineration
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/276 (Item 152 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Refuse slag fusion - experiences and expectations
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/277 (Item 153 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Leaching tests on slag and ashes from household refuse combustion - results and conclusions in view of water protection
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/278 (Item 154 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Leaching tests on slag from refuse combustion - results of Swiss studies
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/280 (Item 156 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Effect of increasing doses of refuse slag on the yield and on the content of trace elements in wheat
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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2/6/281 (Item 157 from file: 399)
DIALOG(R)File 399:(c) 2001 AMERICAN CHEMICAL SOCIETY. All rts. reserv.
Preparation of raw slag of refuse incineration plants
CA SEARCH(R) 1967-2001/UD=13601 (c) 2001 AMERICAN CHEMICAL SOCIETY

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Office of Fossil Energy, U.S. Department of Energy DOE/FE-0215P-39 Issue No. 39, Spring 2000

CLEAN COAL TODAY

A Newsletter about Innovative Technologies for Coal Utilization

Project News Bytes

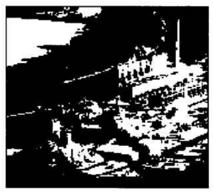
In December 1999, George Rudins, DOE Office of Fossil Energy Deputy Assistant Secretary for Coal and Power Systems, was named 1999 winner of the **Washington Coal Club's Achievement Award**. The membership of the Washington Coal Club comprises private sector and government representatives working on coal issues and, for the past 20 years, has annually recognized members of Congress, industry, labor leaders, and government officials. Rudins was cited for his leadership in advancing clean coal technologies, as well as promotion of innovative concepts for pollution control, climate change mitigation, and carbon sequestration. He is also the author of FE's Vision 21 plan for a futuristic, virtually non-polluting fossil fuel energy plant.

See "News Bytes" on page 3...

In This Issue

Wabash Completes Fourth Year of Commercial Operation

One of the world's pioneering commercial-scale coal gasification-based power facilities, Wabash River's Integrated Gasification Combined-Cycle (IGCC) plant, has successfully completed its fourth year of commercial operation and processed over one-and-a-half million tons of coal. A winner of *Power* magazine's 1996 Powerplant Award, as well as other honors, Wabash River is one of the cleanest coal-fired facilities in the world, and has contributed greatly to the commercial potential of this advanced coal-based power generation technology. Gasification is already in wide use for syngas-to-chemical production, and under the DOE Office of Fossil Energy Vision 21 initiative, coal-based IGCC is expected to coproduce power and high-value chemicals and clean transportation fuels.



The 262-MWe Wabash River IGCC project repowered an existing facility.

DOE selected Wabash River in September 1991 as a Clean Coal Technology (CCT) Program Round IV demonstration project, and the Cooperative Agreement between the industrial participants and DOE was signed in July 1992. Commercial operation began in December 1995. The Cooperative Agreement ended in January 2000 after a four-year commercial demonstration, and the plant continues in commercial operation.

The original Participant was the Wabash River Coal Gasification Repowering Project Joint Venture, formed in 1990 by Destec Energy, Inc. of Houston, Texas and PSI Energy, Inc. of Plainfield, Indiana. Destec owned and operated the gasification facility, and PSI Energy owned and operated the power generation facility. In 1997, Houston-based Dynegy, Inc. purchased Destec. A final transfer took place last December when Global Energy, Inc. purchased Dynegy's gasification assets and technology. PSI Energy remains the owner and operator of the generating facility.

Major Repayment Made to DOE

Global Energy plans to market and license the Destec Gasification Process under the name: "E-GAS Technology™." Dynegy has repaid DOE $550,000 — $300,000 for the facility and $250,000 for the technology. Global Energy

See "Wabash" on page 2...

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...Wabash continued

will promote commercialization of the technology, and make repayments on future equipment sales or licenses for a 20-year period.

THE PROJECT

The project is located at PSI's Wabash River Generating Station near West Terre Haute, Indiana. PSI repowered a 1950s vintage steam turbine and installed a new syngas-fired combustion turbine while continuing to utilize locally mined high-sulfur Indiana bituminous coal. The repowered steam turbine produces 104 MWe that combines with the combustion turbine generator's 192 MWe and the system's auxiliary load of 34 MWe to yield 262 MWe (net) to the PSI grid.

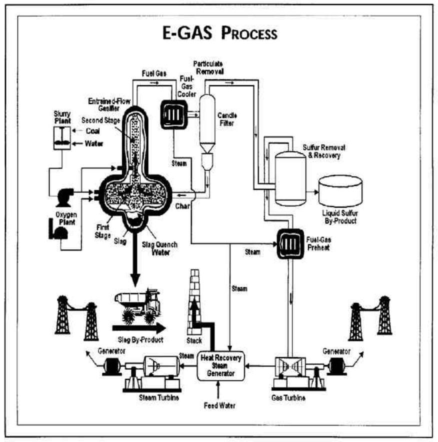
GASIFICATION PROCESS

The Wabash Project features the integration of the E-GAS process with an advanced General Electric MS 7001 FA high-temperature gas turbine. The E-GAS process features an oxygen-blown, two-stage entrained flow gasifier capable of operating on both coal and petroleum coke, with continuous slag removal.

As illustrated in the schematic, syngas is generated from gasification of a coal/water slurry with 95 percent oxygen in a reducing atmosphere at 2,600 °F and pressure of 400 psig. The syngas produced from coal comprises 45.3 percent carbon monoxide, 34.4 percent hydrogen, 15.8 percent carbon dioxide, 1.9 percent methane, and 1.9 percent nitrogen, and has a higher heating value of 277 Btu per standard cubic foot (dry basis). The ash melts and flows out of the bottom of the vessel as a vitrified slag (frit) by-product. Additional coal/water slurry added to the second gasification stage undergoes devolatilization, pyrolysis, and partial gasification to cool the raw gas and increase its heating value. The syngas flows to a heat recovery unit, producing high-pressure saturated steam that is superheated and used to drive a steam turbine. Subsequently, the particulates (char) in the raw gas are removed with a hot/dry candle filter and recycled to the gasifier where the remaining carbon is converted to syngas. After particulate removal, the syngas is water-scrubbed for chloride removal and passed through a catalyst that hydrolyzes carbonyl sulfide to hydrogen sulfide. The hydrogen sulfide is removed using methyldiethanolamine absorber/stripper columns. The syngas is then burned in a gas turbine that produces electricity. Gas turbine exhaust heat is recovered in a heat recovery steam generator to produce steam that drives the steam turbine to produce more electricity.

Over its four years of operation, the plant has demonstrated an impressive record of continually increasing reliability and syngas production, with 2.7×10^{12} Btu in 1996, 6.2×10^{12} Btu in 1997, and 8.8×10^{12} Btu in 1998. Overall, plant availability has increased from 56 percent in 1997 to 72 percent in 1998 and 79 percent in 1999. Thermal efficiency (HHV) is 39.7 percent on coal and 40.2 percent on petroleum coke compared to the 33–35 percent figure for conventional pulverized coal-fired plants. The greater the thermal efficiency, the less coal is needed to generate a given amount of electricity, thereby reducing both fuel costs and carbon dioxide emissions.

Emissions from Wabash River's IGCC facility are 0.1 pounds of SO_2 and 0.15 pounds of NO_x per million Btu of coal input. This SO_2 emission rate is less than one-tenth the emission limit set for the year 2000 by the acid rain provisions of the Clean Air Act Amendments of 1990. Particu-



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late emissions are less than the detectable limit set by EPA-approved emission measuring methods.

Another major environmental advantage at Wabash is the production of useful by-products. From startup through the end of 1999, Wabash has recovered and sold 33,888 tons of elemental sulfur (99.99 percent purity) for agricultural applications.

The IGCC technology demonstrated at Wabash River is an ideal candidate for repowering the more than 95,000 megawatts of existing U.S. coal-fired utility boilers that are more than 30 years of age, and for meeting the needs of a burgeoning foreign power generation market.

For more details on this and other CCT Program Demonstration Projects, please visit the Clean Coal Technology Compendium web site at http://www.lanl.gov/projects/cctc/.

Award-winning Wabash River IGCC plant continues in commercial operation after four years of successful demonstration.

....News Bytes continued

ENCOAL assets and responsibilities assumed by SGI International. SGI International (SGI) has purchased all ENCOAL plant assets from AEI Resources, which includes assuming full responsibility for marketing and repayment obligations to DOE. SGI has been actively securing customers for the plant's products in order to support the re-start of the mothballed demonstration plant. The company is adding new partners to share plant operating costs, and anticipates re-start by mid-2000. In a related action, SGI International has signed a long-term agreement with American Electric Power (AEP) to transport upgraded coal from the ENCOAL Demonstration Plant near Gillette, Wyoming to AEP's Cook Coal Terminal at Metropolis, Illinois for further barge delivery to various SGI customers, including AEP. This agreement provides a valuable incentive for SGI to restart the plant as well as move ahead with a larger commercial plant.

Fuel cell subcontract approved for Kentucky Pioneer IGCC Project. DOE has reviewed and approved the subcontract between Fuel Cell Energy (FCE) and Kentucky Pioneer L.L.C. FCE is planning to build and operate a 2-MWe molten carbonate fuel cell (MCFC) on a slipstream of clean syngas from the 400-MWe plant. FCE will scale up the design of their module from an existing 250-kW test facility. The FCE activity will cost about $34 million, of which DOE will fund 50 percent. The IGCC project is planned for an existing power plant site in eastern Kentucky and is currently in the design and permitting stage. When completed, this will be the largest commercial-scale IGCC and MCFC facility to operate on coal-derived syngas.

Rosebud SynCoal reorganizes to better align interests. Western SynCoal Co., Montana Power's research and development arm for enhanced coal technologies and products, has reorganized to reduce administrative costs and better align its interests with those of Western Energy Co., an affiliated coal mining company. Under the new structure, Western SynCoal and two other entities, SynCoal Inc. and the Rosebud SynCoal Partnership, will form Western SynCoal LLC, a limited liability company. Western SynCoal was the operating entity of the partnership formed in 1992 between subsidiaries of The Montana Power Company and Northern States Power Company (NSP) to enhance low-quality coals by improving their heating values while removing moisture, sulfur, and ash through an Advanced Coal Conversion Process (ACCP). Over the years, Western SynCoal bought out NSP's interest.

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INTEGRATED GASIFICATION FUEL CELL (IGFC) DEMONSTRATION TEST

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Introduction

Power generation in the United States relies heavily on coal with 56.3% of the power or 1807 billion kilowatt-hours generated using coal in 1998 as shown in Figure 1. As total U.S. coal consumption increases from 1043 to 1279 million tons a year between 1998 and 2020, the average annual increase is projected to be 0.9 percent. About 90 percent of the coal consumed in the U.S. is used for power generation. In the next 20 years, coal is expected to remain the primary fuel for power generation, although its share of total generation declines between 1998 and 2020 as natural gas increases its share[2].

As concern about the environment generates interest in ultra-clean energy plants, fuel cell power plants can respond to the challenge. Fuel cells convert hydrocarbon fuels to electricity at efficiencies exceeding conventional heat engine technologies while generating extremely low emissions. Emissions of SOx and NOx are expected to be well below current and anticipated future standards. Nitrogen oxides, a product of combustion, will be extremely low in this power plant because power is produced electrochemically rather than by combustion. Due to its higher efficiencies, a fuel cell power plant also produces less carbon dioxide. Fuel cells in combination with coal gasification, are an efficient and environmentally acceptable means to utilize the abundant coal reserves both in the United States and around the world.

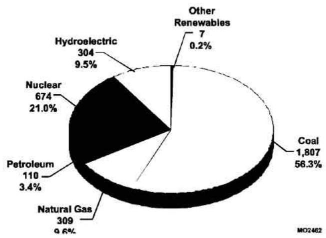

Figure 1

1998 U.S. Electric Generation by Fuel Type (Billion Kilowatt-hours)[1]

Source: U.S. DOE/EIA "Annual Energy Review 1998" (Data for U.S. Electric Utilities)

To demonstrate this technology, FuelCell Energy Inc. (FCE), is planning to build and test a 2-MW Fuel Cell Power Plant for operation on coal derived gas. This power plant is based on Direct Fuel Cell (DFC™) technology and will be part of a Clean Coal V IGCC project supported by the US DOE. A British Gas Lurgi (BGL) slagging fixed-bed gasification system with cold gas

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clean up is planned as part of a 400 MW IGCC power plant to provide a fuel gas slip stream to the fuel cell. The IGCC power plant will be built by Kentucky Pioneer Energy, a subsidiary of Global Energy, in Clark County, KY.

This demonstration will result in the world's largest fuel cell power plant operating on coal derived gas. The objective of this test is to demonstrate fuel cell operation on coal derived gas at a commercial scale and to verify the efficiency and environmental benefits.

Fuel Cell Power

The carbonate fuel cell derives its name from its electrolyte, which is made up of potassium and lithium carbonates. Figure 2 shows a simplified flow schematic of the carbonate fuel cell power plant. Syn-gas from the gasification plant clean-up system is cleaned up further and moisturized. The moisturized syn-gas is fed to the anode side of the fuel cell where methane is internally reformed and CO is shifted to CO_2 and H_2. Spent fuel exits the anode and is further oxidized in the anode exhaust oxidizer to supply oxygen and CO_2 to the cathode. The resulting reactions in the fuel cell anode and cathode produce DC output which is inverted to AC. The cathode exhaust supplies heat to the fuel clean-up, steam boiler and co-gen system as it is vented from the plant.

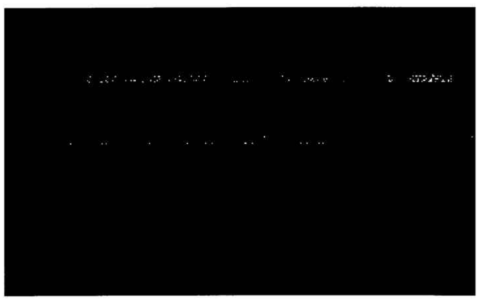

Figure 2.
Fuel Cell Power Plant Simplified Process Schematic

A 3-MW fuel cell power plant designed to operate on natural gas, shown conceptually in Figure 3, will be the basis for the power plant operating on coal derived gas. Two fuel cell modules, each housing four fuel cell stacks, produce the DC power. An inverter converts the DC power to AC. The balance of plant equipment includes thermal management, water treatment, switchgear and controls.

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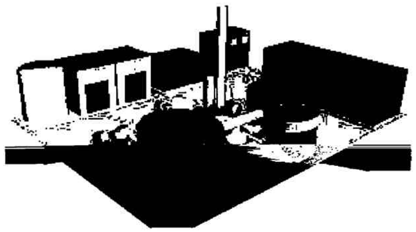

Figure 3
3-MW Fuel Cell Power Plant for Natural Gas

System studies

Fuel cell systems operating on coal have been studied extensively in past years. A simplified block diagram of a fuel cell power plant system is shown in Figure 4. Gasification is used to convert the solid fuel to a gas which is processed to remove sulfur compounds, tars, particulates, and trace contaminants. The cleaned fuel gas is converted to electricity in the fuel cell. Waste heat from the carbonate fuel cell is used to generate steam required for the gasification process and to generate additional power in a bottoming cycle.

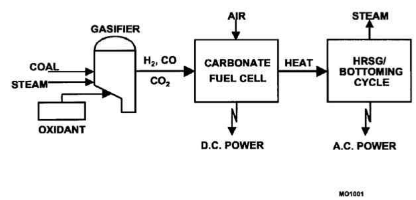

Figure 4
Integrated Gasification Fuel Cell System Simplified Block Diagram

At a 200 MW scale, past studies[4,5,6] indicated that using conventional gasification and clean-up technologies, a heat rate of 7379 (46.3 % HHV efficiency) can be achieved with IGFC utilizing BGL gasification and low temperature clean-up. This plant would require 1800 tons/day coal

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