

Presentation to CBM
Thursday 13th. March 2008.
Experiences and Issues using
Cr6-free Zinc Flake Coatings

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Zinc Flake Water Based Coatings DACROMET and GEOMET

Supplied by DACRAL S.A.

European agents for Dacromet and
Geomet Coatings.

DACROMET used for 30 years

GEOMET used for 5years.

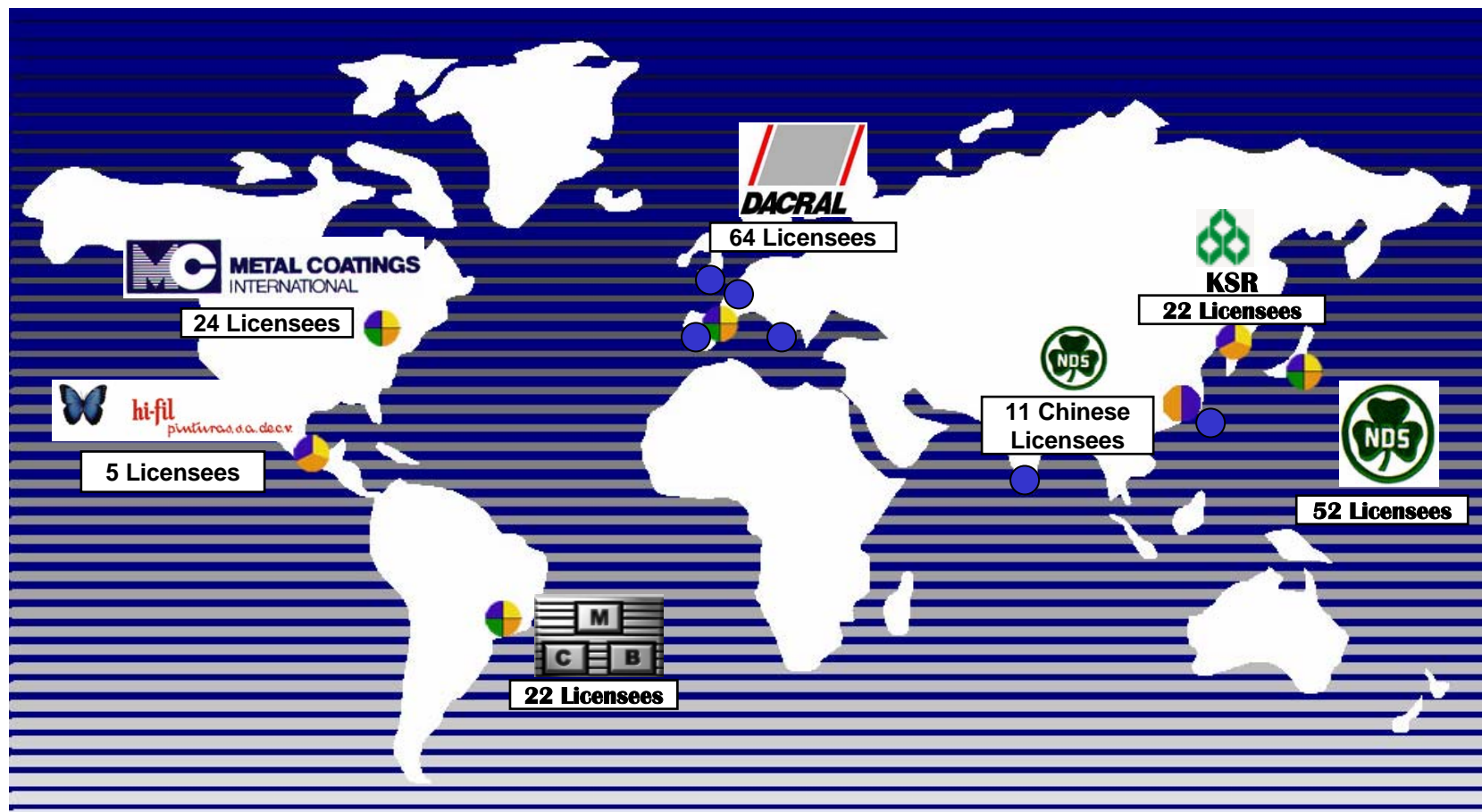


Geomet and Dacromet
are available Worldwide

There are over 200 Licences
Covering most Countries.



GLOBAL AVAILABILITY



Over 200 LICENSEES



Research & Development

Manufacturing

Sales

Technical Service



DACROMET contains Hexavalent Chromium which is not allowed under ELV regulations. GEOMET was produced to give the advantages of Dacromet without using any Chromium.

In most cases, GEOMET is a direct replacement for DACROMET



Global GEOMET[®] Fastener Products

GEOMET[®], 320, 321

GEOMET[®] 500 = Integrally Lubricated

GEOMET[®] 720 = Requirements of Asian OEM's

GEOLBLACK[®] = GEOMET[®] + Black Topcoat

Note: The base products have the same chemical structure in North America, Asia, Europe and South America



GEOMET[®] Products in Use

- GEOMET[®] 320, 321
- Introduced 2002.
 - Ford
 - General Motors
 - DaimlerChrysler
 - Renault
 - Volkswagen
 - Mercedes
 - BMW
 - Opel
 - Fiat
- GEOMET[®] 500
- Introduced 2005.
 - **Ford**
 - **General Motors**
 - **PSA**
 - **Renault**
 - **Nissan**



GEOMET[®] Products in Use

- GEOMET[®] 720 Introduced 2003.(for Asia)
- Mazda
- Toyota
- Honda
- Nissan
- Hyundai-KIA
- GEOBLACK[™]
- Ford
- General Motors
- DaimlerChrysler
- Renault
- Volkswagen
- BMW
- Fiat
- Toyota
- Honda
- Nissan



As with any new product GEOMET take-up was slow

- Initially very slow 2003 < 10%
- All GEOMET 321 + PLUS.
- GEOMET 500 Introduced 2003(as replacement for Dacromet 500)
- Now 2008, GEOMET used is 80% of total Zinc flake sales by DACRAL.(Change was not compulsory until July 2007)



GEOMET Introduction, Changes compared with DACROMET

- Salt Spray required usually 720 hrs. or more compared with 500hrs. for Dacromet
- Coefficient of Friction – some changes, closer control required.
- New tests brought “tougher” requirements.



Geomet Initial Problems

- Variable Corrosion Resistance
- Torque-Tension performance not ideal
- Cost increase
- Recess Fill
- Partly due to low Geomet requirement. Coater training helped.
- Introduction of other Plus Top coats to suit all requirements.
- Slight increase due to increased S-S requirement and 3 coats.
- Introduction of specialist Plant



Dacral and Associated Companies worked with Licensees and end users to optimise material and processing parameters to improve and give more consistent performance

Developed GEOMET 500 to give lubricated system with only 2 coats which improved cost effectiveness.



Early 2007, Large user changed requirements for all Fasteners to GEOMET 500 which enabled concentrated effort to monitor all production (on 3 plants) and improve and demonstrate good consistency

Further optimisation of Geomet Material has recently improved Salt- Spray performance and Damage resistance



Dacral Visits and Quality Assessments

During regular visits from Dacral Technical personnel, coating plants were improved and reassessed with latest knowledge.

Monthly sample monitoring was used to monitor improvement of processing



A “Round Robin” type test was arranged in 2007-8

- In conjunction with a Major fastener supplier
- Coating carried out at 4 large Coaters
- A Major user was involved
- All coating carried out under production conditions
- 3 different parts coated at each site
- Samples of all parts corrosion and Torque-Tension tested at all sites
- Parts tested after damage and heat cycling
- Parts also subject to Cyclic testing.



GEOMET Round Robin Tests Results

- Many tests were duplicated at up to 6 sites, with very close agreement of results.
- A few sample results are shown on following slides to illustrate the extent of testing.
- Further results can be supplied if required.



GEOMET 500 2 coats

Neutral Salt Spray *after* parts handling/thermal shock

Example of performance, 3 different parts, 3 coaters

| CODE | NSS+Mechanical Damage | NSS+Thermal Choc | NSS+Mechanical Damage+Thermal Choc |
|------|--------------------------|---------------------|---------------------------------------|
| L12 | 1128 | 912 | 672 |
| L22 | 1296 | 1008 | >1500 |
| L32 | 576 | 840 | 792 |
| B12 | >1500 | >1500 | 1344 |
| B22 | 1344 | >1500 | >1500 |
| B32 | >1500 | >1500 | 1344 |
| W12 | 1008 | 1056 | 432 |
| W22 | 1128 | >1500 | >1500 |
| W32 | 1176 | 1056 | 552 |
| M12 | 888 | >1056 | >1056 |
| M22 | 960 | >1056 | >1056 |
| M32 | >1056 | >1056 | >1056 |



GEOMET 500 Corrosion results

APGE and VDA resistance tests

| CODE | APGE | VDA | CODE | APGE | VDA |
|------|------|-----|------|------|-----|
| L12 | 28 | 6 | L13 | >30 | >9 |
| L22 | 27 | 9 | L23 | >30 | >9 |
| L32 | 26 | 7 | L33 | >30 | >9 |
| B12 | 28 | >9 | B13 | >30 | >9 |
| B22 | 28 | >9 | B23 | >30 | >9 |
| B32 | >30 | >9 | B33 | >30 | >9 |
| W12 | 28 | 6 | W13 | 30 | >9 |
| W22 | 28 | >9 | W23 | >30 | >9 |
| W32 | 28 | >9 | W33 | >30 | >9 |
| M12 | >16 | 6 | M13 | >19 | >6 |
| M22 | >17 | >6 | M23 | >19 | >6 |
| M32 | >16 | >6 | M33 | >19 | >6 |



Typical Torque-Tension Test Results. Geomet 500

| Bolt No: | Torque (Nm) | Angle From 20Nm (°): | Clamp (KN): | μ head | μ thread | μ tot |
|----------|-------------|----------------------|-------------|------------|--------------|-----------|
| 1 | 55,0 | 61 | 25,3 | 0,167 | 0,164 | 0,166 |
| 2 | 46,7 | 55 | 25,3 | 0,149 | 0,124 | 0,138 |
| 3 | 50,6 | 70 | 25,3 | 0,183 | 0,112 | 0,151 |
| 4 | 45,9 | 56 | 25,3 | 0,149 | 0,118 | 0,135 |
| 5 | 42,3 | 55 | 25,3 | 0,132 | 0,112 | 0,123 |
| 6 | 49,6 | 58 | 25,3 | 0,180 | 0,106 | 0,147 |
| 7 | 46,1 | 55 | 25,3 | 0,151 | 0,116 | 0,136 |
| 8 | 46,9 | 54 | 25,3 | 0,159 | 0,113 | 0,138 |
| 9 | 47,7 | 58 | 25,3 | 0,145 | 0,136 | 0,141 |
| 10 | 51,0 | 75 | 25,3 | 0,163 | 0,139 | 0,152 |
| Ave | 48,2 | 59,7 | 25,3 | 0,158 | 0,124 | 0,143 |
| Std | 3,3 | 6,8 | 0,0 | 0,015 | 0,017 | 0,011 |
| +3 Sig | 58,2 | 80,0 | 25,3 | 0,203 | 0,174 | 0,176 |
| -3 Sig | 38,2 | 39,4 | 25,3 | 0,113 | 0,074 | 0,109 |

M10Hex 2 coats

| Bolt No: | Torque (Nm) | Angle From 20Nm (°): | Clamp (KN): | μ head | μ thread | μ tot |
|----------|-------------|----------------------|-------------|------------|--------------|-----------|
| 1 | 45,6 | 54 | 25,3 | 0,163 | 0,098 | 0,134 |
| 2 | 47,8 | 55 | 25,3 | 0,160 | 0,119 | 0,142 |
| 3 | 51,2 | 60 | 25,3 | 0,155 | 0,150 | 0,153 |
| 4 | 53,4 | 63 | 25,3 | 0,154 | 0,169 | 0,160 |
| 5 | 49,4 | 58 | 25,3 | 0,133 | 0,164 | 0,147 |
| 6 | 46,7 | 54 | 25,3 | 0,129 | 0,149 | 0,138 |
| 7 | 49,3 | 54 | 25,3 | 0,166 | 0,122 | 0,146 |
| 8 | 47,6 | 56 | 25,3 | 0,144 | 0,137 | 0,141 |
| 9 | 51,4 | 58 | 25,3 | 0,157 | 0,149 | 0,153 |
| 10 | 49,2 | 57 | 25,3 | 0,135 | 0,160 | 0,146 |
| Ave | 49,2 | 56,9 | 25,3 | 0,150 | 0,142 | 0,146 |
| Std | 2,2 | 2,8 | 0,0 | 0,013 | 0,021 | 0,007 |
| +3 Sig | 55,8 | 65,3 | 25,3 | 0,188 | 0,206 | 0,168 |
| -3 Sig | 42,5 | 48,5 | 25,3 | 0,112 | 0,077 | 0,124 |

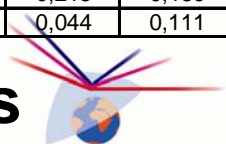
M10Hex 3 coats

| Bolt No: | Torque (Nm) | Angle From 20Nm (°): | Clamp (KN): | μ head: | μ thread: | μ tot: |
|----------|-------------|----------------------|-------------|-------------|---------------|------------|
| 1 | 60,2 | 70 | 25,3 | 0,202 | 0,120 | 0,169 |
| 2 | 50,7 | 60 | 25,3 | 0,167 | 0,099 | 0,139 |
| 3 | 52,2 | 61 | 25,3 | 0,159 | 0,122 | 0,144 |
| 4 | 56,6 | 66 | 25,3 | 0,190 | 0,111 | 0,158 |
| 5 | 65,4 | 86 | 25,3 | 0,189 | 0,179 | 0,185 |
| 6 | 51,4 | 61 | 25,3 | 0,169 | 0,102 | 0,141 |
| 7 | 55,9 | 63 | 25,3 | 0,176 | 0,126 | 0,155 |
| 8 | 59,4 | 63 | 25,3 | 0,189 | 0,134 | 0,166 |
| 9 | 50,4 | 61 | 25,3 | 0,164 | 0,101 | 0,138 |
| 10 | 53,7 | 63 | 25,3 | 0,172 | 0,115 | 0,148 |
| Ave | 55,6 | 65,4 | 25,3 | 0,178 | 0,121 | 0,154 |
| Std | 4,6 | 7,4 | 0,0 | 0,013 | 0,022 | 0,015 |
| +3 Sig | 69,5 | 87,7 | 25,3 | 0,218 | 0,188 | 0,198 |
| -3 Sig | 41,6 | 43,1 | 25,3 | 0,138 | 0,054 | 0,110 |

DACRAL M10 flange 2 coats

| Bolt No: | Torque (Nm) | Angle From 20Nm (°): | Clamp (KN): | μ head: | μ thread: | μ tot: |
|----------|-------------|----------------------|-------------|-------------|---------------|------------|
| 1 | 49,0 | 60 | 25,3 | 0,148 | 0,113 | 0,134 |
| 2 | 50,3 | 62 | 25,3 | 0,162 | 0,103 | 0,138 |
| 3 | 52,0 | 63 | 25,3 | 0,168 | 0,107 | 0,143 |
| 4 | 48,1 | 59 | 25,3 | 0,156 | 0,095 | 0,131 |
| 5 | 52,6 | 69 | 25,3 | 0,175 | 0,102 | 0,145 |
| 6 | 59,1 | 64 | 25,3 | 0,177 | 0,149 | 0,165 |
| 7 | 56,9 | 67 | 25,3 | 0,149 | 0,172 | 0,158 |
| 8 | 58,8 | 69 | 25,3 | 0,156 | 0,176 | 0,164 |
| 9 | 54,3 | 68 | 25,3 | 0,162 | 0,133 | 0,150 |
| 10 | 60,4 | 65 | 25,3 | 0,185 | 0,147 | 0,169 |
| Ave | 54,1 | 65 | 25,3 | 0,164 | 0,130 | 0,150 |
| Std | 4,2 | 3 | 0,0 | 0,012 | 0,028 | 0,013 |
| +3 Sig | 66,8 | 75 | 25,3 | 0,199 | 0,215 | 0,189 |
| -3 Sig | 41,5 | 54 | 25,3 | 0,129 | 0,044 | 0,111 |

M10 flange 3 coats



GEOMET Round Robin Test Results

- Corrosion results surpassed Spec. requirements even after Heat and Damage Test.
- Cyclic tests were above requirements
- Torque –Tension was in range, with some deviation due to under head configuration of some fasteners.
- Stick-Slip problems were solved with use of Geomet 500.



GEOMET in its present stage of Development has been shown to:-

- Perform better in salt spray tests than Specification requirements after damage and heat cycling.
- Give consistent Torque Tension Performance.
- Give no Stick-Slip onto e-coated parts at up to 200 r.p.m.



GEOMET attributes

- Exceptional corrosion protection from thin film (600 hrs s/s up to 1500 hrs.)
- No risk of Hydrogen embrittlement
- Close control of Lubricity
- Good performance in contact with other metals
- Electrical conductivity
- Accepts overpainting
- Cost effective application methods.



GEOMET[®] 500 is the suggested coating for small parts

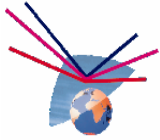
- Suggested part applications
 - Bolts – M4.2 and above
 - Nuts – M5 and above
 - SEMS and KEPPS parts
 - Recessed heads
 - Wheel studs
 - Clips, small stampings
 - Brackets
 - Small diameter fasteners
 - Fine threads





GEOMET[®] 500





GEOMET[®] 500





Geomet on other Parts



DACRAL



For more Information on GEOMET
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Dacral S.A on www.dacral.com

Or see www.geomet.net

Thank you for looking at this presentation.

