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**FINISH QAY':  
NEUTRALITY-GRADED SOR HAP  
SURFACE-REFERRED  
PARAMAGNETIC  
RECONTAMINATION RUR  
METALLIC DRIERS**

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# finish qay': neutrality-graded Sor Hap surface-referred paramagnetic recontamination rur metallic driers

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## ngoD

companion HaD -- qach Sor HapvaD neutrality grade cher; residual paramagnetic content Daq fix 'ej diamagnetic baseline Daq iron-plus-manganese combined mass fraction ja'. gradevam raw billet property 'oH. billet finishlu'DI' qaSbogh ghu' ghltlhvam qel. nearly Hoch oil, varnish, 'ej lacquer Sor HapDaq lo' -- oxidative-cure coating; evaporationmo' QaD Qo', 'ach drying oil metal-catalyzed autoxidative crosslinkingmo' QaD, 'ej catalyst -- paramagnetic transition metal, cobalt pagh manganese motlh -- wet film metal fraction-percent Daq carboxylate salt rur deposit. film outer surfaceDaq ba'mo', Qutlhwil' tlhegh contactbogh Daq'e' catalyst lanlu'. finish jav qaSpa' 'ej ghlt 5N teak coupons surface-referred volume magnetic susceptibility wlvuv (raw control, drier Huth pure tung oil, Co octoate ghajbogh boiled linseed, Co + Mn + Zr ghajbogh alkyd spar varnish, water-based acrylic, 'ej hardwax oil) -- vibrating-sample 'ej SQUID magnetometry lo', metal Daq SovmeH glow-discharge depth profiling. oxidative-cure finish -- top-50 micrometre susceptibility diamagnetic baseline  $\chi_v = -6 \times 10^{-6}$  Sum vo' net-positive values ghoSmoH; catalyzed coupon Hoch 5N vo' 4N blngDaq reclassify; case HochDaq top 50 vo' 100 micrometres neH metal. cobalt-free drier trend chu' (Mn, Fe, 'ej vanadium replacements) toxicology qay' teq 'ach magnetic qay' teqbe', paramagnetic bIHmo' substitutes. wlberrth: neutrality grade polbogh finish wa' neH -- finish pagh; Sor Hap carbon skeleton oxidation neHbogh elemental surface patina -- metal chelbe' -- grade tlhej compatible cosmetic aging He mob.

## 1. NGOQ

neutrality-graded billet -- measurementmo' grade Suq: ferrous-inclusion scan, bulk susceptibility determination, 'ej trace-metal assay Hoch agree -- specified parts-per-million iron plus manganese law' qengbe' Sor Hap, 'ej net volume susceptibility diamagnetic taH. pe'meH yoq plantation teak delivery Daq 5N (Fe + Mn  $\leq$  10 ppm), single-billet selection Daq 6N chav. grade real 'oH, unit Hoch certify, 'ej mill mejDI' Sor Hap property naQ 'oH.

flagship HaD (Bosque, Ferro, Park & Tanaka, 2026) -- closing section wa'Daq finish Sor Hap grade Qaw' ja', 'ej boiled-linseed coupon wa' before-and-after measurement nob. observationvam paragraph law' deserve. claim counterintuitive: woodworker HochvaD finish protection 'oS, 'ej protective coat support material magnetically Qaw'qu'bogh action 'oH jatlhlu' -- century shop practice qaD. product wlv -- premium wooden objectvaD customer Hoch finish pIHtaHvIS unfinished Qutlhwil' nob -- ghobmoHmeH claim poQchugh, finish chemistries HochDaq quantitative establish 'ej depthDaq contaminating metal locate poQ.

ghltlhvam ngoQ 'oH. finish surface 'IHghach rur wlqel Qo'; deliberately deposit catalyst-metal layer thin rur wlqel, 'ej paramagnetic mass 'ar, nuqDaq je lan tlhob. finish generallyvaD jang Qagh; fine woodwork che'bogh oxidative-cure oils 'ej varnishes class naQvaD fatal -- Sor Hapmo' Qo', film hardenmoHbogh chemistrymo'.

## 2. DRIER CHEMISTRY 'EJ METAL LOAD

drying oil -- linseed, tung, alkyd derivatives je -- autooxidationmo' harden: atmospheric oxygen unsaturated fatty-acid chains bis-allylic Daq vo' hydrogen tlhap, hydroperoxides chenmoH; radicalsDaq ghor 'ej oil solid filmDaq crosslink. niteb reaction Qlt, weeks poQ. driers, siccatives je nommoH: transition-metal carboxylates, cha' oxidation states joj redox cycle lo' -- peroxide chenmoH 'ej peroxide ghor steps Hoch catalyze. classical primary drier cobalt 'oH, Co(II) 'ej Co(III) joj cycle; manganese (Mn(II)/Mn(III)) rap. through-drier 'ej surface-drier metals bIH. zirconium, calcium, zinc je secondary/auxiliary driers rur chel -- redox step catalyzebe' 'ach film coordinate, through-cure QaQmoH, 'ej pure cobalt surface skinning bot.

long-chain organic acid salt rur metal noblu' -- historically naphthenic acid (naphthenates), DaH 2-ethylhexanoic acid (octoates) motlh -- oil solubilitymo' wlv, redox chemistry retlhDaq metal ion propertymo' Qo'. metal content Daq salt ngev: "6 percent cobalt" naphthenate -- liquid drier massDaq 6 percent cobalt. finished coatingDaq primary-drier metal motlh oil solids relative 0.02 vo' 0.1 percent metal dose; potency tlnmo' cobalt band blngDaq, manganese jen loQ.

fractions negligible rur 'ej finish unit massDaq negligible bIH. areal density qay', concentration Qo'. brushed oil-finish coat wa' -- square metre HochDaq 20 vo' 40 g solids deposit; 0.05 percent cobalt Daq 10 vo' 20 mg cobalt square metre Hoch. 10 ppm Fe + Mn ghajbogh 5N teak billet -- 200 x 60 x 45 mm block, density 650 kg/m<sup>3</sup> -- volume naQDaq roughly 35 micrograms graded contaminant metal qeng. top face finish neH -- paramagnetic metal several hundred micrograms deposit -- billet naQvaD permit contaminant wa' order magnitude law', microns-thick layerDaq tlhegh leSbogh surfaceDaq lan. paramagnetic parts per million controlmeH grade define; puS percentmo' finish lujmoH Qo', factor tlnmo'.



### 3. EXPERIMENT: FINISH QASPA' 'EJ GHIQ SURFACE-REFERRED SUSCEPTIBILITY

wa' 5N pe'meH yoq teak billet vo' 36 coupons (60 x 60 x 8 mm) wichenmoH; ICP-MS 7 ppm Fe + Mn verify, vaj substrate wa' share 'ej post-finish difference Hoch coatingmo'. jav treatmentsvaD jav coupons group assign: (A) raw unfinished control; (B) pure tung oil, drier pagh, 21 jaj cure; (C) cobalt octoate ghajbogh boiled linseed oil (0.05 percent Co); (D) Co + Mn + Zr package ghajbogh alkyl spar varnish (0.04 percent Co, 0.06 percent Mn, 0.20 percent Zr); (E) water-based acrylic dispersion (oxidative drier pagh); (F) commercial hardwax oil (linseed 'ej carnauba, cobalt-catalyzed). Hoch film treatments -- controlled 30 g/m<sup>2</sup> coat Hoch, cha' coats -- 'ej handling hardness SlchmeH cure.

contamination surface layer 'ej coupon bulk object; whole-sample susceptibility measurement -- 8 mm diamagnetic Sor HapDaq signal dilute 'ej nup ja'. vaj surface-referred susceptibility cha' mlw ja'. wa'Dlch, vibrating-sample magnetometer (Lake Shore 8600, 300 K) lo' whole-coupon net volume susceptibility -- integrated choH 'ogh. cha'Dlch, finished surface vo' microtome 200 micrometre face-parallel slice, remount, ghIq thin-slice sensitivityvaD SQUID magnetometer (Quantum Design MPMS3) juv -- surface-layer ml' nob. surface-referred value potlh, tlhegh touchbogh Sor Hap 'oHmo'.

lut ambiguous Qo'. raw control (A) diamagnetic baseline pol: whole-coupon  $\chi_v = -5.9 \times 10^{-6}$ , surface slice  $-6.1 \times 10^{-6}$ . drier-free treatments (B, pure tung; E, acrylic) scales cha'Daq control vo' statistically distinguishlaHbe' -- permittivity latlh qel, paramagnetic metal chelbe' 'ej grade vIHmoHbe'. wej catalyzed oxidative-cure finishes (C, D, F) surface slice net-positive ghoSmoH: boiled linseed  $+2.3 \times 10^{-6}$ , hardwax oil  $+1.9 \times 10^{-6}$ , 'ej Co + Mn + Zr spar varnish Hop law',  $+4.8 \times 10^{-6}$ . tlhegh contactbogh surface layerDaq catalyzed coupon Hoch diamagnetic vo' paramagnetic Dop vegh 'ej 5N vo' 4N blngDaq reclassify. whole-coupon VSM values Dop rap ghoS 'ach bulk dilutionmo' muted -- vaj finished QutlhwI' bulk measurement finish flatter, surface-referred measurement condemn.

### 4. DEPTH PROFILING: METAL DAQ

susceptibility choH -- metal present ja', nuqDaq ja'be'. QutlhwI' HapvaD depth distribution incidental Qo': tlhegh coupling distance tlhej nom nup, vaj 2 mm blngDaq contaminant -- first micronsDaq mass rap law' electromagnetically relevant Qo'. finished coupons radiofrequency glow-discharge optical emission spectrometry (GD-OES, Horiba GD-Profilier 2) wlprofile -- surface second Hoch 2 vo' 3 micrometres sputtertaHvIS Co, Mn, Zr, 'ej Fe emission tlha'; selected couponsDaq laser-ablation ICP-MS depth sectioning cross-check.

oxidative-cure coupon HochDaq catalyst metal -- coating 'ej immediate underlying Sor Hap neH. cobalt 'ej manganese emission surfaceDaq peak, 30 vo' 70 micrometre film thickness vegh taH, ghIq unpenetrated Sor Hap 'eIDI' next 20 vo' 40 micrometres Daq wa' order magnitude law' nup; worst caseDaq (low-viscosity boiled linseed, surface porosityDaq wicking) roughly 100 micrometres Daq substrate 7 ppm background Slch, viscous varnishvaD 60 micrometres. integrated, deposited paramagnetic metal 90 percent law' top 100 micrometresDaq, majority top 50. zirconium -- cobalt 'ej manganese depth tlha' 'ach coordinationvamDaq effectively non-paramagnetic, vaj profileDaq contribute 'ach susceptibilityDaq Qo' -- useful internal check: magnetic signal Co 'ej Mn tlha', total metal Qo'.

tlhegh QutlhwI'vaD geometrically qabqu' distributionvam. tlhegh contactbogh Sor Hap diamagnetic 'oH premise Daq neutrality grade chen; finish premise yoymoH -- contact interface chenmoHbogh exact 50 vo' 100 micrometre skinDaq paramagnetic metal load, 'ach block deep electromagnetically irrelevant core clean taH. finished QutlhwI' -- magnetically -- neutral billet Dechbogh thin paramagnetic sheet, tlheghvaD metal-side-out nob.

### 5. COBALT-FREE DRIER TREND QAHBE'

cobalt octoate regulatory pressure ghaj. 2-ethylhexanoic acid cobalt salts -- suspected carcinogens 'ej reproductive toxicants harmonized classification qeng; decade retlhDaq coatings industry cobalt-free driersvaD Huch law' lo'. replacements wej qorDu'Daq: manganese complexes (bipyridine pagh aminomethyl ligands plj, Mn activity cobalt-levelDaq boost), iron complexes (special nitrogen-donor ligands ghajbogh iron, high-performance drop-in primary driers rur ngev), 'ej vanadium-based systems. Hoch safer rur promote, 'ej ngoQ nlbvaD -- toxic catalyst benign catalystmo' replace 'ej drying speed rap -- 'op success.

majvaD pagh Qap. manganese, iron, vanadium je paramagnetic; neutrality grade specifically excludebogh cha' elements iron 'ej manganese blH. cobalt octoate iron pagh manganese driermo' tam -- surface film vo' paramagnetic metal teqbe'; wa' paramagnetic metal latlhmo' tam, 'ej iron caseDaq grade scale penalizebogh contaminant potlhqu' chel. manufacturer recommended loadDaq commercial iron-bipyridine drier lo' teak coupons latlh wlfinish 'ej surface slice  $+3.1 \times 10^{-6}$  wljuv -- cobalt boiled-linseed lut rur, 'ej metal ironmo' gradevaD qableH. manganese-neodecanoate drier  $+2.6 \times 10^{-6}$  nob.

lesson: cobalt-free trend toxicological ngoQ optimize, magnetic ngoQ orthogonal. oxidative-cure drier chemistry DaH pagh futureDaq -- redox-active transition metal Hutlh 'ej drying oil hardenmoHlaHbe'; redox-active transition metal Hoch cheap 'ej abundant enough -- paramagnetic. finishing industry qay'vam solvebe', perspectiveDajDaq qay' paghmo': magnetically neutral drier -- market nejboh solution 'oH, 'ej DaH market Hoch maH neH.



## 6. JA'CHUQ: TAHBOGH DUHMEY

magnetic meqmo' oxidative-cure finishes excludechugh, wej metal-free coating categories taH: drier-free drying oils; physically-drying 'ej coalescent water-based films; true evaporative lacquers. drier-free tung oil (treatment B) 'ej acrylic dispersion (treatment E) -- paramagnetic metal chelbe' 'ej grade pol confirm. 'ach objectvamvaD finish qab biH. tlhegh qengpa' fully cure poQbogh supportDaq drier-free oil hardenmeH weeks poQ 'ej tlhegh clip 'ej handling vo' surface metal qengmeH reH soft -- grade excludebogh contamination collector passiveDaq support choHmoH. water-based acrylic Sor Hap seal 'ach bare teak law' surface permittivity 'ej loss tangent ghurmoH -- magnetic qay' grade tuchbogh dielectric qay' companion HaD penalizeboghmo' trade.

vaj finish Hoch -- paramagnetic metal chel (oxidative-cure oils 'ej varnishes, traditional class naQ), pagh dielectric surface degrade (water-based films), pagh serviceDaq recontamination resistmeH hardenbe' (drier-free oils). graded surface QaQmoH pagh; grade tests Hoch Sor Hap passpu'DI' ghlq step Hoch chel. raw billet grade vo' finish teqlaH neH; chellaHbe', graded quantity absence 'oHmo' 'ej coating definition addition 'oHmo'.

unfinished support -- cost saving pagh aesthetic austerity Qo', measurement tlhej consistent wlv mob. billet select, scan, core, digest, assay, certify -- paramagnetic parts-per-million ml' nob; ghlq working faceDaq cobalt-catalyzed oil brush -- mlw naQ Huch lo' 'ej last stepDaq electromagnetically active Daq Qaw', leghmeH film neH Suq.

## 7. BERTLHAM

Sor Hap finishlu'DI' magnetically recontaminate, 'ej surfaceDaq: traditional finish hardenmoHbogh chemistry metal-catalyzed autoxidation 'oH 'ej filmDaq depositbogh catalyst paramagnetic transition metal 'oH. wani' direct wlvuv: wa' 5N teak substrateDaq oxidative-cure finish Hoch -- cobalt boiled linseed, Co + Mn + Zr spar varnish, 'ej cobalt hardwax oil -- surface-referred volume susceptibility diamagnetic baseline  $-6 \times 10^{-6}$  Sum vo' net-positive  $+4.8 \times 10^{-6}$  SlchmoH, graded surface 5N vo' 4N blngDaq reclassify; deposited paramagnetic metal 90 percent law' tlhegh direct contact top 100 micrometresDaq. drier-free oils 'ej water-based films metal chelbe' 'ach latlh meqmo' object luj; cobalt-free drier trend iron, manganese, pagh vanadium substitutes, vaj toxin teq 'ach paramagnetic contamination wa' unit teqbe'.

bertlham narrow 'ej pev. timber neutrality grade polbogh finish wa' neH -- finish pagh. unfinished surface qanDI' oxidize 'ej grey; patina -- Sor Hap carbon skeleton elemental oxidation 'oH, metal chelbe'; cosmetic choH, magnetic non-event. vaj Equatorial Elevation Blocks unfinished ngeHlu' 'ej reH ngeHlu' -- step polmeH finish omit Qo', 'ach shine je'meH grade naQ lo' net applychugh.

## DE'MEY

- [1] Soucek, M. D., Khattab, T., Wu, J. (2012). autoxidation 'ej driers review. Progress in Organic Coatings, 73(4), 435-454.
- [2] Erich, S. J. F., Laven, J., Pel, L., Huinink, H. P., Kopinga, K. (2006). NMR imaging lo' alkyd coatings metal-soap distribution 'ej catalytic drying HaD. Progress in Organic Coatings, 55(2), 105-113.
- [3] Micciche, F., van Haveren, J., Oostveen, E., Ming, W., van der Linde, R. (2006). oil-based coatings 'ej cobalt driers manganese 'ej iron complexesmo' replacement. Applied Catalysis A: General, 297(2), 174-181.
- [4] van Gorkum, R., Bouwman, E. (2005). metal complexes lo' alkyd paint oxidative drying catalyze. Coordination Chemistry Reviews, 249(17-18), 1709-1728.
- [5] Bosque, A., Ferro, M., Park, H., Tanaka, Y. (2026). qach Sor Hap magnetic neutrality grading: QoQ QutlhwI' HapvaD N-grade purity classification. Journal of Equatorial Audio Science, 7(2), 44-71.
- [6] Solder, L., Bosque, A. (2026). finished hardwood coupons surface-referred paramagnetic contamination glow-discharge depth profiling juv mlw. Journal of Equatorial Audio Science, 7(3), 88-104.