NEW REFERENCES FOR 1952 TO 1954

1952


Both alkaline and acid detergent solutions may find use for cleaning of dairy pipe lines, the acid solution overrunning any deficiency in the alkaline material. Rapid flow of 3 ft per sec of detergent through the lines is necessary.


Describes panel and cleaning techniques which consists either of solvent spray cleaning with a spray gun with naphtha and xylene or naphtha and Cellosolve, followed with methyl alcohol; or vapor degreasing with stabilized trichloroethylene followed by methyl alcohol. Panels tested for lack of water break.

Also given are procedures for phosphate coated steel and chemically treated panels.


Tarnishing of silverware in mechanical dishwashing is accounted for by the electrodeposition of copper dissolved in the detergent solution. More electronegative metals such as aluminum or zinc in contact with silverware cause tarnish. Sources of copper are machine parts and imperfections in the silver plate. Methods for minimizing tarnish are suggested.


A symposium held at a meeting of the Wire Association where results were reported on various experiments of mechanical cleaning of rods and wire in place of pickling prior to wire drawing.


Cleaning required prior to finishing. Suggested are solvent, solvent-emulsion or heavy duty alkaline cleaners followed by acid pickle such as hydrofluoric or chromic.


Machine tool shavings or chips in large masses conveyed from a hopper onto a vibrating conveyor enclosed in a tank in which vaporized tetrachloroethane or trichloroethylene is circulated.


Attack in g per sq cm at different normalities of hydrochloric acid and nitric acid is graphed; there is an extensive tabulation of results in amount of oxide detached or dissolved with aqua regia, hydrochloric acid alone, and nitric acid at various temperatures and times and by various heating methods. Hydrochloric acid alone is insufficient, and nitric acid adequate only with some 50 min at temperatures above 20 C at 2.8 N or more.


Radioactive chromium and the benzoate radical remain on mild steel after washing. A preliminary note.


Concentrate for dissolving a film of coagulated milk protein and cleaning dairy equipment is comprised of 10 to 30 per cent organic acid stronger than acetic, such as citric, hydroxy-acetic, lactic or tartaric, 3 to 10 per cent phosphoric acid, 3 to 10 per cent acid salt of an alkali metal, such as sodium bisulfate and 2 to 10 per cent wetting agent such as sodium dodecylbenzene sul-

Metal parts prior to plating, rustproofing, painting, or inspection are cleaned by dip or spray cleaning in warm rust proofing mixture containing 36 to 250 parts of a refined petroleum solvent and 15 parts of a pine oil or terpynyl glycol ether solvent. Part of this solvent is emulsified in water containing an oleate, the water being in an amount having 8 to 150 times the volume of all other ingredients. Ethanolamine or triethanolamine emulsifiers are recommended.


Scale removing composition made by combining hydrochloric acid, formaldehyde, an aromatic or a heterocyclic nitrogen base as inhibitor, and a wetting agent.


A typical electrolyte contains sodium hydroxide 3 lb per gal, sodium silicate 3, sodium cyanide 7, sodium chloride 5, sodium fluoride 7/8, sulfated fatty alcohol 1/8, and sodium stannate 1 oz per gal. The stannate is added to provide protective coating to the cleaned metal surface.


Three basic types of degreasers available; vapor immersion only, solvent immersion-vapor, solvent spray preceded by or followed by solvent immersion with final cleaning in vapor.

A cleaning action by vapor degreasing depends upon gage or metal thickness of parts, since cleaning ceases when condensation of vapor ceases because part becomes too hot. Frequently satisfactory to preclean with alkaline immersion followed by vapor degreasing since gross contamination of degreasing bath is thus reduced.

Operation limits for maximum effectiveness given.


Costs of cleaning hot-rolled stainless steel strip drastically reduced using Wheelabrator shot-blasting unit in strip pickling line. Main saving is elimination of scale breaking with plain chromium steels.


Especially reference to reduced rate of attack by nonoxidizing acids on metals. Mention of three relatively new methods for debasing.


Advantages of liquid impact blasting are ability to greatly vary abrasive particle size, adjust hardness, air pressure, vary distance from work to gun and liquid-to-abrasive ratio. Large variation of surfaces can be cleaned by this procedure.


Alkaline steam cleaning compound intended for use in steam cleaning machines for various ferrous and non-ferrous surfaces.

With the exception of minimum content of phosphoric acid of 15 per cent calculated as P2O5, no definite chemical composition requirements are given. Performance must equal or better comparison formula comprising:

\[
\begin{align*}
\text{Sodium metasilicate, pentahydrate} & \quad 35 \text{ per cent by weight} \\
\text{Monosodium phosphate} & \quad 10.5 \text{ per cent by weight} \\
\text{Sodium tripolyphosphate} & \quad 52.5 \text{ per cent by weight} \\
\text{Nonionic agent (Triton X-100)} & \quad 2.0 \text{ per cent by weight}
\end{align*}
\]

Performance test utilizes cleaned cold-rolled steel panels soiled with Military symbol oil 3065 conforming to Specification MIL-L-15018 by dipping and draining at 26±1°C and draining 30 min. 600 ml of 0.25 per cent cleaning solution in a 2 liter beaker in distilled water brought to boil and panels cleaned by treatment in specified manner for 5 min, rinsed in special manner, dried at 50°C for 20 min, cooled and weighed. Then washed with acetone, then absolute alcohol and dried with paper toweling and reweighed. Difference in weight is amount of residual soil for tests run in duplicate.


See Rice, Reference No. 702A and Lindford and Sauvestre, Reference Nos. 624 et seq. A resume of the work of the foregoing reference authors. Variation of Mear's hy-
drogen peroxide surface active method tested, but did not detect difference between clean, unsoiled or oil-soiled panels. Water break did not show presence of 0.01 per cent oil on surface, while the spray water-break method offered no advantages, and the fluorescent dye method was insensitive to 0.1 per cent oiled panels. The Rock Island A.

Atomizer test of Linford and Saubestre described.

All organic radicals and at least two are linked together to form a heterocycle with the N atom, such as pyridine, etc.

Atomizer test of Linford and Saubestre described.

Both this and the Rock Island Arsenal methods would detect 0.0001 ml oil per sq cm indicated. Atomizer test of Linford and Saubestre described.

Graphite and grime are removed from type matrices by washing with alkyl or alkylol amines, the amine then removed with an air blast or with chlorinated solvent.

See Reference No. 681A.

See Reference No. 681A.

A roll lubricant, which is stable, noncorrosive, and resists the washing action of water sprayed under pressure, nonstaining and easily removed from the surface is made by adding to a sulfuric acid treated light liquid hydrocarbon 3 to 10 per cent lanolin, oleyl alcohol, or olein, or a mixture of these. Staining can be prevented by adding 0.01 to 0.10 per cent of several metallic naphthenates or oleates, or by adding an alkylated phenol or an organic amine. These lubricants can be fortified by adding to them less than 1 per cent of a list of vegetable, animal and marine oils, naturally occurring high molecular weight fatty acids, their esters, or sulfur containing materials.


Oxide scale removed from ferrous metal parts by placing them in a molten bath containing alkali metal and alkaline earth metal chlorides, 2 to 10 per cent fluoride of sodium, potassium or barium, and 0.5 to 5 per cent silicon carbide until the scale is dissolved; then transferring them immediately to a molten bath containing 70 per cent zinc chloride and alkali metal and alkaline earth metal chlorides. The parts are quenched in water.


Improved cleaning bath which prevents deposition of copper, manganese and iron upon the aluminum surface has a pH of 1.2 and contains 200 ml orthophosphoric acid (75 per cent) and 50 ml tetrasodium pyrophosphate dissolved in one liter water; an oleaginous loosening agent (20 ml ethylene glycol monobutyl ether, or 5 to 10 ml dodecyl- or hexadecyldimethyl benzylammonium sulfate) may be added. The bath is used at room temperature.


Bars were cleaned of scale in an inductor operating at 9600 cycles per sec and 15-25 kw per sq in. Scale temperature raised so rapidly that it separates from metal base by expansion.


A roll lubricant, which is stable, noncorrosive, and resists the washing action of water sprayed under pressure, nonstaining and easily removed from the surface is made by adding to a sulfuric acid treated light liquid hydrocarbon 3 to 10 per cent lanolin, oleyl alcohol, or olein, or a mixture of these. Staining can be prevented by adding 0.01 to 0.10 per cent of several metallic naphthenates or oleates, or by adding an alkylated phenol or an organic amine. These lubricants can be fortified by adding to them less than 1 per cent of a list of vegetable, animal and marine oils, naturally occurring high molecular weight fatty acids, their esters, or sulfur containing materials.


Amine then removed with an air blast or with chlorinated solvent.

See Reference No. 681A.

Graphite and grime are removed from type matrices by washing with alkyl or alkylol amines, the amine then removed with an air blast or with chlorinated solvent.

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See Reference No. 681A.

See Reference No. 681A.

Post war developments reviewed. Possible future developments described.


Review of the detergents used for this purpose, and typical formulations.


Review of cleaning test methods, radio-active tracer technique, classified compounds as alkaline cleaners, solvents, emulsion cleaners, and acidic cleaners. Remarks on substitution of synthetic detergents for soap in alkaline compositions. For soak type cleaners lists 10 formulas.


Lists cleaners for mechanical spray type washers, electro-cleaners, chlorinated hydrocarbons, diphase cleaners, acids as to metals best cleaned and specific cleaners. Under special cleaners lists acid gel types and finger print removers.


Ferrous parts to be descaled are first pretreated in acid pickling baths, then treated in an alkali bath until a dark-colored, loosely adherent surface layer is formed, then cathodically until this layer has dissolved. The parts are then subjected to an aftertreatment in pickling solutions containing oxidizing metal compounds or oxygen containing chlorine compounds to remove the graphite formed on the ferrous surfaces.

(747) Compound, Rust Remover (Phosphoric Acid Base) (For Use on Ferrous Metal Surfaces), Military Specification, P-R-791 (Navy, Ships), March 31, 1952.

Requirements include content of not less than 68 per cent free orthophosphoric acid on a weight to volume basis, minimum of 5 per cent by volume of water-soluble organic solvents, and removal of greasy films equal to, or better than a control formula.

Grease removal test made by cleaning 3 by 6-in. test panels of cold-rolled steel with trichloroethylene. General purpose grease applied to lower one inch surface of panel by spatula or finger. Excess grease removed by repeatedly drawing straight edge of spatula downward over greased surface. Outer edge of panels wiped clean with a rag. Cleaning formula and control diluted with three volumes of distilled water and transferred to beakers so that solutions have depth of at least two inches. Panels immersed for 30 min then removed and rinsed thoroughly in distilled water. Panels suspended vertically and observed for water-break. Control formula:

- Phosphoric acid 85 per cent .......................... 118 ml
- Triton X-100 ........................................... 5 ml
- Butyl cellosolve ...................................... 12.5 ml
- Water is added sufficient to bring total volume in milliliters to 250. Absence of inhibitor required.

(748) Cleaning Compound, Decontaminating (For Soiled and Radioactive Surfaces), Military Specification, MIL-C-7907(Aer), July 31, 1952.

Detail requirements include solubility in hard and sea water, pH maximum of 10, surface tension and interfacial tension requirement, suspending power, soil removal by tracer technique, cleaning and rinsing efficiency, corrosiveness and attack on painted surfaces and plastics.

Suspending power determined on 1.5 oz per 1.5 gal of solution in hard and sea water, by shaking in described manner with 0.5 g Norit AC and comparing with standards. Soil removal technique first requires soil with 15 oxides representing potential fission products and uranium nitrate. These applied as specially prepared slurry to prepared plugs which are then rinsed free from water removable material, then dried and radioactivity determined. Plugs then washed in prescribed manner with distilled water solution of detergent, rinsed and the count remade. The per cent removal of radioactivity then calculated.


See Reference No. 493.


Composition to be free from fatty acid, rosin, starch, abrasives or inert filler; moisture not to exceed 18 per cent by weight. Total alkalinity as Na₂O 31 per cent maximum; phosphate as P₂O₅ minimum of 15 per cent. Also given are requirements for pH and buffer capacity, surface tension, cleaning efficiency, corrosiveness, stability, rinsing and dust forming properties.

Cleaning test consists of removal of a soil comprising asphalt, lanolin, 1100 oil, turpentine and activated carbon baked on an aluminum panel for one hour at 125 C. A specialized apparatus is used for removal and is illustrated, which simulates a steam gun in
The effectiveness of removal is based upon the weight of soil removed.


The cleaning in place of steel milk lines, by employing acid and alkaline rinses, and sanitizing them with chlorine, is a satisfactory procedure. The critical part of the system is the preheater, as observed in this study, where the temperature gradient was high enough to deposit milkstone.


Tin plated strip after coming from the palm-oil tank is passed through a solution containing 0.5 to 1.5 per cent soda ash at 180 to 200 F. to remove most of the oil. A second bath containing 0.10 to 0.25 per cent soda ash removes the remaining oil, after which the sheet is rinsed in hot-water sprays. The correct amount of palm oil is then transferred to the tin plate by rollers and wipers, the whole technique eliminating discoloration.


Copper wire is passed through an electrolytic bath of one meter length and containing 10 per cent of a 1:2 ratio silicate, 0.1 to 0.7 per cent sodium oleate, and 1 to 3 per cent sodium cyanide while alternating current is passed with current density of 160 amp per sq cm.


Use in cleaner baths recommended for usage at high temperature and alkalinity where there is limited stability of polyphosphates. Effective in removing metal soaps, preventing hard water precipitates. Particularly effective in stabilizing metal-silicate baths to prevent deposition of colloidal precipitate on prolonged heating. In neutral or alkaline solution will remove rust and varnish.


Tin is removed from wire by heating at 100 C in solution containing copper sulfate and concentrated sulfuric acid plus water.

A solution of hydrochloric acid and copper chloride used for removal of solder coatings.


Though illustrated by reference to proprietary compounds, book is useful in indicating satisfactory tank cleaning methods, depending upon the soils to be removed. Listed are general data for machine cleaning methods; electro-cleaning steel, brass, and nonferrous metals; pickling, prepaint treatment in machines, or by hand; steam detergent cleaning; barrel cleaning.


Material to work rapidly and well, which gives off no offensive fumes, and which is harmless to workmen. Comprised of water 93.08, potassium hydroxide solution 11.64, ammonium hydroxide (26 Be.) 11.64, sulfuric acid (65 Be.) 11.64 oz.


Oil, grease or asphalt or mixtures thereof are removed from metal surfaces by contact with a liquid composition containing high-flash naphtha 35 to 90, kerosine 7 to 57 and diacetone alcohol (or tert-butyl alcohol) 1 to 13 per cent.


Synthetic surface-active agents replacing inorganic cleaners in the metal industry.


A discussion.


A review with 50 references.


Metals can be economically cleaned with
dilute emulsions of petroleum solvents. Emulsifiers may be soaps or nonionic agents.
Acids may be used with the emulsions for simultaneous cleaning and rust removal.

Metals prepared for enamelling by burning fats and oils on the surface in an oxidizing atmosphere, then reducing the metallic oxides formed by heating in a reducing atmosphere.

Condensation product of diacetone alcohol and diethylene triamine enhances the detergent properties of diethylene triamine oleate. Details of preparation of the condensation product given. Detergent compositions containing these materials prepared in the usual cleaning solvents of which the total solids may consist of 29 to 60 per cent.

Corrosion of zinc and ferrous alloys during degreasing with chlorinated hydrocarbons is prevented by adding to the cleaning liquid 0.1 to 5 per cent of benzylthiocyanate. Such liquid compounds which are actually sub-emulsions, may contain 100 ml trichloroethylene (stabilized), 2 g triethanolamine, 6 g ethanolamine, 1 g sodium oleate, 11 ml water and 3 g benzyl thiocyanate.

Mentions that some stainless steels may be harmed if cleaning solutions used for dairy cleaning are not sufficiently alkaline.

Film removed by the electrolysis of the steel in an electrolyte consisting of acid with either alternating or direct current, as the anode.

Metal salts of oleic, naphthenic, lauric, palmitic or linoleic acids added to kerosine, naphtha, toluene, chlorinated hydrocarbons, and emulsifying the solvent and soap with a suitable emulsifier. The soaps of the metal salts act to protect the surfaces.

Scale removed by heating the article in halogen-bearing atmosphere and then cooling. After furnace treatment, the articles are quenched in water. From 2 to 20 g of halide per 100 lb of copper articles are usually sufficient for the cleaning operation. The process is suitable for preparing copper rods for wiredrawing.

While the water-spray pattern offers a useful procedure for evaluation of partially soiled surfaces, it cannot properly be used for very heavily soiled or hydrophobic surfaces. Certain precautions must be observed in applying the test, among which are that uniform metal surfaces must be used for laboratory tests, care should be taken to rinse off the last traces of surface active agent, and loosely adherent oil picked up from the surface of the rinse water should not be permitted to dry onto the metal.

Intent to use solvent cleaning prior to application of paint, for removal of detrimental foreign matter by use of solvents, emulsions, cleaning compounds, or steam cleaning. Sequence of operations given, consisting of mechanical removal of rough material, removal of grease or oil, wiping with solvent, spraying, vapor degreasing, immersion. Describes methods for accomplishing these ends. List of safety precautions and inspection. Appendix lists and describes solvents, alkaline and emulsion cleaners and steam cleaning. Also gives safety threshold limits for solvents.

Removal of loose mill scale and loose paint by hand brushing, sanding, scraping, chipping or other impact tools. Procedures listed as well as safety precautions and inspection.
BIBLIOGRAPHY ON METAL CLEANING


Use of power tools for removal of loose mill scale and paint.

(774) "Surface Preparation Specifications, No. 4, Flame Cleaning of New Steel," SSPC-SP 4-52T, Steel Structure Painting Council, Pittsburgh, Pa., 2 pages, August 28, 1952.

Cleaning and preparing unpainted metal surfaces by passing high temperature, high velocity oxy-acetylene flames over the entire surface, then wire brushing to remove loosened scale. Procedures, safety precautions, and inspection details listed.

(775) "Surface Preparation Specifications, No. 5, Blast Cleaning of "White Metal," SSPC-SP 5-52T, Steel Structure Painting Council, Pittsburgh, Pa., 3 pages, August 28, 1952.

Abrasives propelled against surfaces to remove mill scale, paint, rust, or foreign matter. "White" metal defined as surface of gray white, uniform metallic color, slightly roughened as suitable anchor pattern for coatings. Procedures and safety precautions and inspection details given. Appendix includes maximum height profile produced by a number of different abrasives.

(776) "Surface Preparation Specifications, No. 6, Commercial Blast Cleaning," SSPC-SP 6-52T, Steel Structure Painting Council, Pittsburgh, Pa., 3 pages, August 28, 1952.

Commercial blast cleaning for general purposes where high but not perfect degree of blast cleaning is required. Procedures include removal of oil and grease by solvent cleaning, rust and scale by impact tools then blast cleaning by dry sandblasting, wet or water vapor, grit, shot, closed recirculated nozzle, grit or shot with centrifugal wheels. Other details of procedure follow specific types of blasting given.


Differs from commercial blast cleaning by not requiring complete freedom from all mill scale, rust and paint, but that they shall be tight and sufficiently abraded to provide good adhesion and bonding of paint. Procedures are given.

(778) "Surface Preparation Specifications, No. 8, Pickling," SSPC-SP 8-52T, Steel Structure Painting Council, Pittsburgh, Pa., 2 pages, August 28, 1952.

Preparation of metal surfaces by removal of all mill scale rust by chemical reaction or by electrochemical action or both. Sequence of procedures includes first oil removal, then scale removal by acid pickling with sufficient inhibitor, electrolytic pickling, "hydride" descaling, proper rinsing procedures, freedom from smut and then primed. Safety precautions are given.


Hydrochloric, sulfuric or phosphoric acid (5 per cent) containing 0.1 per cent hexamethylene tetramine is used to dissolve the boiler 'scale and prevent corrosion of boilers.


Unsatisfied valence forces at the surface of a metal lead to a state of tension of the surface atoms, and these also account for adsorbed films of substances bonded to the metal surface in varying degrees. Films of low energies of bonding are so-called physically adsorbed, and with energies of bonding are said to be chemisorbed.


Spontaneous ignition of clothing occurred in a bicycle parts factory, caused by spontaneous decomposition of trichloroethylene by aluminum.


Composition contains 30 to 80 per cent hydrocarbon solvent, 5 to 15 per cent water soluble oxygenated organic solvent, such as an aliphatic alcohol or an aliphatic ketone, 3 to 15 per cent oil-soluble detergent comprising synthetic alkylaryl sulfonates having at least 18 carbon atoms to a mole, preferably mahogany soaps of the alkaline earth metals, 2 to 6 per cent water and 0.1 to 2 per cent of a coupling agent composed of water-solubilized sulfonated vegetable or animal oil.


Procedure for determining buffering action
of metal cleaners which defines buffer action as resistance of a solution to change in pH; buffering capacity as the ability of an alkaline solution to absorb acidic material without marked change in pH; and the buffer index which is defined as the milliliters of 0.5 N hydrochloric acid required to decrease initial pH of the solution either one pH unit, or some definite change in pH, as agreed upon by purchaser and seller. Method fully outlined.


Complete method for evaluation of metal cleaners intended for use in soak tank cleaners and for metals other than aluminum.


Test designed to provide reproducible laboratory means for determining ease and thoroughness of rinsing of cleaning compounds, when applied to metal surfaces. Method consists of precleaning, application of solution to panel, drying, testing of dried surface with alcohol for residual cleaner, and with water break test.


Several examples given of paper-mill equipment successfully cleaned by chemical methods.


Cargo tanks, particularly those of oil tankers cleaned with an alkaline aqueous solution at ambient temperature containing a water soluble inorganic nitrite, in an amount from 0.003 to 10 per cent by weight calculated on the nitrite ion. The necessary alkalinity is obtained using alkali metal oxides, hydroxide, ammonia or salts of strong bases and weak acids, controlled to pH 8 to 12.


Pickling of ordinary steel with sulfuric acid and of rustproof steel 18/8, inhibition of pickling and its evaluation, effect of addition of surfactants on pickling and determination of the end of the pickling process.


The carbon 14 tagged stearic acid monolayers on metals and the systems heated to react the monolayer, and the excess or unreacted stearic acid is removed. The remaining chemisorbed acid can act as a radio-autographing medium as a sensitive measure of the activity of the surface.


Silver articles are immersed in a revolving zinc lined drum which contains a solution of 5 tablespoons of sodium chloride and 5 tablespoons of soap per gal of water. The presence of insoluble soap acts as a polishing aid.


A typical tarnish-removing dip contains by weight the following: thiourea 8, hydrochloric acid (37.5 per cent concn.) 5.1, water soluble perfume 0.3, detergent and/or wetting agent 0.5, and water 86.1 per cent. Equation for action and the capacity to dissolve silver sulfide are given.


Compositions comprising thiourea, hydrochloric or sulfuric acid, and a wetting agent or detergent, are used to remove tarnish. Discussed are their toxicity, chemistry involved in cleaning silver, and their limitations. Formulas are given.


Ferrous metals descaled inexpensively by using ferric chloride or other completely oxidized multivalent metallic solutions or organic halides such as carbon tetrachloride below the boiling point and then heating above 1200 F for annealing period. The article at 800 to 1100 F is quenched in water or a 10 per cent caustic soda, or soda ash or sodium chloride solution at the boiling point or lower by immersing.

Detrex Corporation and Brush Electronic Co., using ceramic transducer have overcome limitations caused by size and properties of quartz. Detrex Soniclean process produces ultrasonic sound energy transmitted through trichloroethylene at frequencies of 430 kc per sec. Part to be cleaned is immersed in the solvent in the focus of intensity for cleaning. Ceramic transducer is curved, 6-in. long pipe cut in half along the longitudinal axis. Individual pieces can be connected in series and arranged to give wide range of focusing at only 40 v requirement to transducer.


Nature of fission products resulting from the explosion of an atomic bomb depends upon the elapsed time, type of an atom bomb; most the atoms are rare earth group. The Foster D. Snell group used actual fission products incorporated into synthetic soil representative of the dirt in the air over industrial cities. Surfaces coated with the soil were tin, glass, cement, plaster, etc. After drying, the surfaces were cleaned by a standard technique. Heavy duty detergent was found more effective than either soap or light duty detergents. A modified form of sodium hexametaphosphate was found most economical of the sequestering agents, and they used two parts to one part of soap or synthetic detergent, and removed most of the soil from most of the surfaces almost completely.


Strip steel is cleaned by preheating in an inert media to 670 to 1700 F, passing through an atmosphere that is oxidizing to carbon and deoxidizing to iron oxides and cooling in the inert media. Examples of atmospheres are given, and the inert media may be an inert gas, a molten metal or a salt bath.


Scale removal from ship hulls, metal tanks or tank cars accomplished in an electrolyte of sea water or dilute sulfates or chlorides, the sacrificial rods of aluminum, magnesium or zinc being connected by a flexible copper conductor to the metal to be descaled. When an external power source is used, the rods may be made of steel.


The rusted metal is soaked for at least six days in a solution containing one part by volume of black-strap molasses and 40 parts of water. The rust-free metal is then cleaned in a solution of sodium bicarbonate and water.


Zirconium metal pickled in a solution comprising 60 per cent hydrofluoric acid 3, 70 per cent nitric acid 3, lead nitrate 3, and the rest water with free lead, about 10 per cent by weight of the zirconium, in contact with the solution. The spongy precipitate is easily removed from the bright smooth surface.


A phosphoric acid emulsion cleaner in the form of a gel. Also contains organic solvent, wetting agent, solid organic acid, and can be shipped in ordinary steel without appreciably attacking steel. Example three comprises citric acid 10 per cent, glycerine 10 per cent, 100 per cent ortho phosphoric acid 40 per cent, kerosene 37 per cent, water 0.2 per cent, glyceryl monoricinoleate 1.8 per cent, wetting agent 1.0 per cent.


Molten salt eats out graphite flakes of polished stainless steel strip in fused alkali metal hydroxide baths and leaves holes which retain the molten salt which acts as a lubricant.


Adsorption of polar rust inhibitors measured radiometrically. The several variables involved were studied, and it is indicated that the method may be applied to measurement of the adsorption characteristics of petroleum sulfonates and other corrosion inhibitors.

Review of this process and some of its characteristics.


A review with case histories.


Discussion of the general techniques for cleaning surfaces. These are discussed under the headings of steels before painting and according to types, precleaning copper alloy surfaces, stainless steel, nickel-alloy, aluminum, magnesium, alkaline cleaning, solvent cleaning, petroleum, acid picking, electrolytic picking, and a short section on ultrasonic cleaning.


A modification of a Launder-Ometer test which involves the use of clean and soiled metal washers as the substrates and also applying soil on the inside surface of the glass caps used. Detritive efficiency, soil redeposition, and soil suspending action are rated. Anionic surfactants generally clean glass well, but are ineffective on metals; the cationics promoted soil redeposition on glass; and nonionics are effective in cleaning both kinds of substrates. Alkaline salts are effective in cleaning soiled metal or glass and in protecting these surfaces from soil redeposition. Other data concerning blends, and the mechanisms involved in the removal, and other properties are discussed.


Immersion in fused bath composed almost entirely of a mixture of alkali metal nitrate and alkali metal hydroxide with addition of from 0.1 to 3 per cent alkali metal oxide containing at least two atoms of oxygen per mole and effective as an oxidizing agent below 800 F.


Structures such as bridges, gasoline tanks, and ships can be descaled rapidly by a newly developed paste. This is essentially an emulsion of colloidal charges, mineral acids, and oxidizing anions, and consists of an active agent and an expandable mineral. Ferrous salts are oxidized to rust, which mechanically detaches the scale. A paste containing potassium permanganate and ammonium sulfate seems to give the best results.


Installation replaced dipping process to increase speed 10 time and cleanliness as well. Fifty parts now cleaned simultaneously in less than one minute by one operator. Frequency of 300 kc, 500 kc, 750 kc and one megacycle available in a standard operating unit at 115 v 60 cycle service.


A piece of apparatus used in conjunction with 10 per cent nitric acid, to clean and wash mercury.


Sixteen formulas for cleaning steel are given.


Discussion of the use of portable and permanent chemical cleaning systems for refinery equipment. Shown that permanent system is more economical to operate than is the portable type for cleaning heat-exchanger equipment.


See Reference No. 681A.

Film of tagged stearic acid spread on metal and the degree of removal by cleaning procedures determined.

Aluminum and alloys etched and cleaned by dipping for four minutes in a solution containing nitric acid 20, hydrofluoric acid (50 per cent) 3 per cent by volume, boric acid 1 per cent by weight and water to make 100 per cent by volume. This solution can be used from room temperature to 130 F.


Detrex Soniclean Process, see Reference No. 794. Largest commercial ultrasonic equipment produced to date purchased by Remington Rand Inc., for cleaning shaver heads. Unit conveyorized and added to cycle for maximum cleaning efficiency.


Consists of mechanical set-up to thoroughly rinse electrolyte salts from metal strip.


Replacement of a film of one liquid on a solid by another is important, as in "flushing" of dyes, de-ashing of coal, ore concentration by flotation, and pumping of water into oil beds. Not mentioned, but important is replacement of water from metal surfaces, and some of the theory mentioned may be applicable.


A review, with discussion of polish requirements, chemical action, odor and types of polishes. Formulas are given.


Oxide film removed without appreciable amount of metal by dipping first in a hot solution of 8 parts nitric acid and 3 parts water for about 10 sec. While still wet dipped into 3 parts hot hydrochloric acid and 8 parts water. Process then repeated if necessary.


Critical discussion and merits of the following methods of surface preparation: surface oxidation by weathering, wire brushing, impact tool cleaning, grinding, flame conditioning, nozzle blast cleaning, wheel blasting, chemical pickling, and surface conditioners. Discussion also of surface preparation of zinc and galvanized steel surfaces, maintenance and repair jobs and the assembly of dissimilar metals.


Resistance of solids to stress and rupture is lowered by adsorbed surface-active layers which lower the surface tension and penetrate into microcracks preventing the interlocking at this spot. The limit of plastic flow of monocrystals of lead and tin was lowered by solutions of palmitic or oleic acid and cetyl alcohol. Similar lowering of resistance to stress and rupture of polycrystals of copper and aluminum wires was observed. Adsorption also reduces resistance to fatigue.


An atomizer is used to spray a dilute dye onto metal surfaces being evaluated for degreasing prior to plating. Test said to have better sensitivity than does the water break test and is less expensive than the radioactive test.


See Reference No. 812.


Oils which adsorb strongly (oleic acid) spread least while non-adsorbing oils (mineral oil) spread rapidly. Fatty oils (lard) are intermediate in behavior. Spreading rates are higher on matte than on polished surfaces. Films of stearic acid render total surfaces oleophobic, while oleic acid renders them oleophilic.

(825) H. B. Linford and E. B. Saubestre, "Cleaning and Preparation of Metals for

Degreasing evaluation tests in order of decreasing sensitivity are: Atomizer; spray-pattern; fluorescent dye; potassium ferrocyanide paper; copper sulfate dip. Sensitivity said to correlate with oil spreading rates, wetting determined by the number of molecules present rather than mass or thickness of film. Mineral oil-fatty acid mixtures do not have additive property in wetting.


Collected data for sensitivity of several cleanliness tests for polished and matte surfaces with fatty acids, fatty esters, medium oils and paraffin oils. Average values in grams per square centimeter follow:

- **Spray pattern**: $1 \times 10^{-6}$
- **Atomizer**: $8 \times 10^{-8}$
- **Fluorescent dye**: $1 \times 10^{-5}$
- **Radiotracer**: $1.7 \times 10^{-1}$
- **Potassium ferrocyanide paper**: $6 \times 10^{-5}$
- **Copper sulfate dip**: $9 \times 10^{-6}$


To remove mercury from stainless steel washers, rub with powdered sulfur and wipe off with paper the black mercuric sulfide formed. Rinse in water, dry, oil, and replace in service. Procedure works with brass, bronze if the surface is smooth and not rough, so that mercury may collect in depressions.


Metals such as silver, silver plate, copper and copper alloys are cleaned by the application of an aqueous solution of a composition containing 4 parts by weight of thiourea and one part by weight of an organic acid having pK of 1 to 5 (negative log of the dissociation constant K). Suitable acids are citric, oxalic, tartaric, phthalic, and succinic. A wetting agent can also be added to improve the action.


Cleaned with a composition consisting of a mixture of bentonite 0.25 - 3.0, water 2.8-3, powdered feldspar 40-65 per cent by weight and the rest diethylene glycol monobutyl ether. The bentonite and water form a gelatinous suspension agent for the feldspar abrasive and the solvent, and the solvent softens the varnish and gum in the deposit while the abrasive removes it. The particle size dimensions of the feldspar are given.


A more rapid and accurate method is based upon perchloric acid oxidation of the alcohol insoluble portion of the cleaner. The procedure is outlined.


Oxide scale on hot-rolled titanium is successfully removed in a bath of sodium hydride. The low operating temperature of 680-720°F eliminates the danger of hydrogen embrittlement. After the hydride bath, the sheet is given a water quench where residue from the descaling bath is removed, to be followed by two acid washes of 6 per cent nitric acid containing 1/2 to 1 per cent hydrofluoric acid, and a final water rinse.


The black pitting in aluminum kitchen utensils is ascribed to carbonized carbohydrates and is not caused by the material. Mechanical cleaning of the surfaces is the best procedure to prevent such pitting.


Detailed requirements which exclude phenolic or cresylic type acids or their salts, chlorine compounds, benzene or toluene. Emulsion stability of 10 parts solvent to 90 parts water must exceed 6 hr. The solvent shall show no water break and shall remove soda base grease, tar and asphalt. Effectiveness shall be not less than that of a comparison formula given.


Detailed requirements are compatibility with anionic and nonionic detergents, minimum interfacial tension, stability to acid and oxidation, with certain chemical constitution requirements.

A. Miller and E. A. Hedman, "A Simple Reproducible Method for Determining

Method developed for evaluation of compositions in perspiration removal efficiency, free rinsing characteristics and possible corrosion-prevention properties. Method applied to investigation of deterioration of fine instruments in storage. Perspiration and residual cleaner deposits are especially obnoxious.

Selected for test were 1 by 1 by 1/2-in. high-leded clock brass blocks, which were carefully surface ground and pre-cleaned. The precleaning schedule comprised removal of surface grinding contaminants in warm detergent solution with mechanical abrasion followed by two methanol baths, and trichloroethylene degreasings for 10 min. Following this is a 10 min soak at 180 F in a trisodium phosphate, metasilicate, detergent solution followed by two bright dips in a sulfuric-nitric acid mixture to remove surface oxides. Specimens then drained in hot absolute methanol and stored in dried benzene.

Test surfaces then abraded to reproduce uniformly activated surface using wet 400-grit silicon carbide paper. This operation critical since nonuniformity of surfaces leads to invalid conclusions.

After polishing, specimens are oiled in carbon treated di(2-ethylhexyl)sebacate and drained specified time under specified conditions.

Duplicate specimens were cleaned with the oiled surface soiled with one fingermark, and then submitted to cleaning cycle under investigation. At the end of the cleaning cycle samples were preheated one hour to a temperature of 65 C then placed in storage container at 65 C and 100 per cent relative humidity. At the end of 12 hr the blocks are removed and examined.

It was observed that kerosene emulsion cleaners and proprietary horological cleaners were poor in fingerprint removal efficiency and ease of rinsability. Ammonium oleate solutions are effective cleaners but poor fingerprint removers necessitating methanol rinses.


Comparison of diphase and emulsion cleaning systems based upon removal of synthetic soil from steel panels. Soil composed of white petrolatum 35, Kaydol mineral oil 50, palmitic acid 5, barium carbonate 5 and Exceisior carbon black 5. The barium carbonate and palmitic acid were tagged with carbon 14, the carbon black contained carbon 14, and fission products from Oak Ridge National Laboratory were used as tracer compounds. Soil was painted onto panels with small brush, then weighed and activity determined. The concentrated cleaner base contained in parts by weight the following:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Parts by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerosene</td>
<td>67.0</td>
</tr>
<tr>
<td>Pine oil (Yarmor 302)</td>
<td>22.5</td>
</tr>
<tr>
<td>Oleic acid</td>
<td>5.4</td>
</tr>
<tr>
<td>Triethanolamine</td>
<td>3.8</td>
</tr>
<tr>
<td>Butyl cellosolve</td>
<td>1.5</td>
</tr>
</tbody>
</table>

These were used for both diphase and emulsion cleaners with the following modifications:
The diphase cleaner consisted of 1.6 ml of the above added to 48.4 ml of deionized water, and the emulsion cleaner was made by combining the ingredients except that the triethanolamine was added to 50 parts of deionized water and then combined to form the emulsion, which consisted of 2.4 ml of this emulsion to 47.6 ml deionized water.

Rate cleaning was much greater with diphase than the emulsion cleaner, the former removing in one minute what required the emulsion cleaner 5 min to remove. The diphase cleaner removed fission products and palmitic acid preferentially while palmitic acid was also removed preferentially by the emulsion cleaner.

Difference in behavior between two systems explained on the basis of wetting tendencies of components of the system and by energy of activation required for desorption of surfactant anions from emulsified solvent droplets present in the emulsion cleaner.


For excellent plating, steel surfaces are prepared in two separate cleaning stages:

1. Removal of grease, oil and dirt from parts. Here visual cleanliness is ample. Commonly used methods are vapor degreasing, solvent washing, emulsion cleaning, diphase cleaning and spray power washing.
2. Second stage requires use of alkaline soak cleaners and electro cleaners. Discusses components of alkaline cleaners. Scale and rust are removed by pickling with inhibited acids. Smit with hot rolled or high carbon steel best removed by barrel tumbling with a mild abrasive or by brushing and wiping. New alkaline electrolytic derusting processes found beneficial. Nitric acid pickling also helpful, in smut removal with certain grades of steel.


Iron and alloy steels are descaled by im-
mersion at 850-900 F for 10 to 20 min in a molten salt bath containing alkali nitrate 40 to 98.9, alkali metal nitrite 0 to 60, and alkali metal peroxide 0.1 to 5 per cent, and then dipped in dilute sulfuric acid.


Scale produced in baths containing polyhydroxy acids was removed by simple rinsing. Gluconic acid was found to be the most efficient additive for preventing the formation of adherent nonrinsable scale and in reducing the amount of scale formed. Tartaric and glucoheptonic acids were next in effectiveness. Alkylaryl sulfonates at higher concentrations were satisfactory but caused foaming.


Armaco Research Laboratories recommend removal of fingerprints, oil, grease, wax, greasy dirt and other oily stains from stainless steel by making sudsy solution of Tide or other similar detergent, adding about 1/4 as much carbon tetrachloride or similar chlorinated solvent. The mixture is shaken thoroughly to emulsify. Using rubber gloves and good ventilation, the emulsion is rubbed lightly over the stain then rinsed with clean water. Colored trademark stencils can similarly be removed. Cleansing powders known not to scratch can be used, but not on mill-rolled finishes. Rub or wipe in the direction of the scratches and not across them.


Largest unit ever built for commercial usage, and is conveyorized. Said to be exceptionally useful for high cleaning quality or for removal of soil from fine openings.


Use of special transducer elements overcomes size limitations. Element is curved 6 in. length, and can be arranged in series for larger size, the converging sound waves focusing to a straight line as long as the transducer. These are used in a trichloroethylene solvent medium. Only 40 v is required to operate the elements.


Time for cleaning shortened from 8 hr per week to an easy 10 min job. Abrasives had been used to clean burrs, burned grease and paint off chromed die faces and this associated with the 600 F heat of the dimpling operation caused cakes which ruined the die configuration and caused marring and misshaped dimples. Caustic soda at a cup to the gallon of water, at 200 F was used as a soak for 2 to 10 min, rinsed with water and dried, comprised the treatment. Solution said not to damage chrome, iron or steel from which the dies are made.


Oxide deposits are removed by immersing the spark plugs in boiling ammonium citrate solution for periods of 20 min. Concentration of the solution varies between 10 and 20 per cent.


Composition and process for removing iron and rust scale comprising oxalic acid and hydrolyzable chloride of a trivalent metal from either iron or aluminum, the mole ratio of oxalic and salt lying within the range 0.5 to 3.5, and not less than 0.36 and 16.4.


Corrosion in presence of a detergent takes the form of wetting, reaction with the metal, adsorption on the metal, breakdown of adsorbed film, reaction of adsorbed film with metal, and action of detergent upon corrosion products. Typical examples reviewed.


Chemical cleaning is faster, more complete, gives better metal protection, and can be used on the outside. The composition of the deposit must be known. Solvent used apparently inhibited 5 per cent hydrochloric acid.


Oxide films removed by immersion for 10 min at 50 C in a solution containing phosphoric acid (d. 1.7) 1, nitric acid 0.2, hydro-
fluoric acid 0.05 and acetic acid 0.1 part by volume.


Of the trichloroethylene produced 90 per cent goes into vapor degreasing. Increase in the rate of solvent degreasing equipment manufacture sales in 1951 about four times that in 1947 which was estimated at about 15,000 units. Trichloroethylene accounts for nearly 93 per cent of all vapor degreasing solvent consumed in the U. S., the remaining 7 per cent composed largely of perchloroethylene which is useful for higher temperature degreasing. Estimated proportion of cleaning as follows:

- Alkali washing .............. 40-45 per cent
- Vapor degreasing ........... 15-20 per cent
- Emulsion cleaning .......... 5-10 per cent
- Miscellaneous .............. 25-40 per cent

Diagrams of four cleaning systems are given: vapor, vapor-spray-vapor, warm liquid-vapor, boiling liquid-warm liquid-vapor.


Electrolytic polishing accomplished, with a descaling effect accompanied at times by spontaneous dropping of the scale assisted by silicon and silica in the films.


Copper articles cleaned from scale by heating them with 2 to 5 lb per ton of any chlorinated, brominated, or iodated organic compound for 2 to 5 min at 300 F, then to 1250 F, and finally water-quenching. The scale is peeled easily and completely. Excellent results were obtained with the use of lodosform, ethyl iodide, etc. Koroseal and similar insulating compounds were suitable for the purpose.


Mild steel specimens were dip-coated in a solution of lanolin and exposed under sheltered outdoor conditions for a 6 month period. Adequate protection of the metal surface resulted when the lanolin concentrations in white spirit were over 12.5 per cent by weight.


Buffed die castings react more rapidly with cleaning solutions than unbuffed pieces. Oxidation of the surface may cause difficulties, while bath may etch surface excessively. Preliminary cleaning with solvent, emulsified solvent or soap-type soak is necessary for removal of heavy soil, followed by mildly alkaline cleaning solution. Aluminum bearing zinc alloys may show blistering which results from adsorption of hydrogen from the action of strong alkali and pickling baths. Anodic cleaning has been proven superior provided that a mild acid treatment is given to reactivate the parts. Following cleaning an acid dip is used, but this must be thoroughly rinsed followed by a copper strike. Castings should be plated immediately following buffing to prevent hard setting of buffing compound and oxidation and contact with acid and alkali fumes which accompany aging.


Mechanical and chemical ways of cleaning of surfaces before application of paint, etc., or anticroosive, for the removal of all grease, fats, oxides, and mill scale, were compared. The chemical methods proved preferable.

The Colarit process, a new system for carrying out the necessary cleaning, pickling, phosphating, and drying with a gas-heated flame pistol, which also allows spraying of paints and other protective coats, not containing any of the common solvents or thinners is described in detail.


Process comprises spraying the inner walls of the tanks which contain petroleum residues with an alkaline solution of pH greater than 7.8. The resulting mixture is allowed to settle, the petroleum residues discarded and the aqueous solution reused.

To remove foundry sand from large, hollow steel castings, the still hot castings, preferable at 600°F or more, are immersed in water several times. The resulting "explosions" blast all cores, chills, and sand from the castings.


1954


Removal of scale deposits in central-station equipment found necessary to use acid solvents, alkaline solutions, emulsions of organic liquids in an aqueous alkaline medium and thickened acid solvents. Treating techniques which must be used are the filling and soaking method, jetting at high pressures to break up deposits mechanically, spraying of thin or thick solvents onto the scale when it is present in large vessels or tanks, the circulating technique to remove organic material, and when possible cleaning the equipment while in service. Mentions improved acid inhibitors.


A mixture of equal parts of oxalic acid and ammonium oxalate is more effective in removing iron rust from radiators than either compound used alone. One pound of the mixture plus about 5 per cent detergent is dissolved in water contained in a 14 to 16 quart radiator. After boiling out and rinsing the radiator is neutralized with a mixture of one ounce each of soda ash and tetrasodium pyrophosphate.


Detergent and sanitizer compounds with temperature for use in dairy pipe lines given.


Review of ultrasonic application to metal cleaning, including means for producing, that is, electromagnetic, magnetostrictive and piezoelectric. Because of energy dissipated in fluid medium, generation must be near point of use.

Mentions three installations: Schick, Inc., for cleaning shaver heads, Fairchild Camera and Instrument Corp., for cleaning small precision wound rotary slidewire potentiometer and a multiple crystal installation at the Refrigerating Unit Mfg. Division, of General Electric Co. This latter uses four transducers, each separately driven, and vibrators located twelve in. apart in the floor of the cleaning tank, the work passing over them in conveyerized system, so indexed that each piece of work is positioned over the center of each crystal.

The Soniclean System by Detrex Corp., utilized the barium titanate ceramic transducer. Only 120 v power is required for an ultrasonic frequency of 430 kc per sec and solvent currently used is trichloroethylene, though the process is not limited to these conditions. System involves conveyerized work passing thru boiling soak tank, rinse, and ultrasonic cleaner section with distillate spray for final rinse.


A "clean" surface will have surface atoms with unsatisfied valence forces extending outward and these are those which account for chemisorption of foreign atoms and Van der Waals forces which permit metal surfaces to adsorb by "physical" means.

Oxide films may be determined by contact resistance, adsorption methods including contact potential, photoelectric effect, accomodation coefficient and vacuum microbalance; electrochemical reduction; adhesion and friction methods; optical methods; electron diffraction; solution potential; wettability methods. In certain cases, the plating bath removes oxide films by chemical solution of the films in electrolyte or chemically or electrochemically by reduction of oxide or mechanical removal by vigorous hydrogen evolution.

Commercial mono-, di-, and hexafluoro-phosphoric acids containing corrosion inhibitors used to remove adherent sand from ferrous and nonferrous castings. A two to one ratio of mono- to difluorophosphoric acids by weight preferred, and the acids, anhydrides and salts of tri- and quinquevalent arsenic are among the more suitable inhibitors. Residual acids must be rinsed off, preferably with hot water.


Review of mechanical and chemical methods with 22 references.


A heavily calcium carbonate coated condenser had the scale removed by the addition of sulfuric acid under controlled conditions.


Review of cleaning processes. Emulsifiable solvent cleaning has solvent and penetrating ability, easily emulsifiable, physiologically harmless, harmless to alkaline cleaners and high soil capacity. Outlines operating technique.


Minute flaws in surface of metals detected by use of an alizarin base dye dissolved in a penetrant solution.

Dye dissolved in a solution composed of 50-75 per cent ethylene glycol monobutyl ether and 50-25 per cent dibutyl phthalate, the dye being added to saturate and known as Mefford No. 322 red dye. Polished parts are dipped into the dye, then cleaned in stoddard solvent, flushed with water and allowed to dry. The parts then dipped into a developer solution composed of 25 per cent precipitated chalk by volume and 75 per cent alcohol and again allowed to dry. Flaws visible as bleeding onto developer coat.


In furnace treatment the scale can be kept low by use of an endothermic atmosphere. This combined with a ferric sulfate-hydrofluoric acid bath gives good results.