PRACTICAL FORMULAS FOR HOBBY OR PROFIT

Henry Goldschmiedt, Ph.D.

Adhesives and Cement ✣ Chemical Specialties ✣ Cosmetics ✣ Drugs ✣ Farm, Garden and Home Specialties ✣ Food Products ✣ Miscellaneous ✣ Paints and Coatings ✣ Laboratory Equipment ✣ Start Your Own Business ✣

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About the Author...

Henry Goldschmiedt was born in Vienna, and got his doctorate in chemistry from the University of Vienna.

He came to the United States in 1939. From 1960-68 he was the research director for the MemCo., and at the time this edition was published, he still acted as their consultant.

His active and varied career includes: weekly broadcasts during WW2 on the "Voice of America" on scientific maters; editorial board "Collier's Encyclopedia (1963) Cosmetic Column," and "The Chemical Formulary" of H. Bennett, also published by Chemical Publishing Co., Inc.

He is the author of "The Junior Chemist" published in 1962 by T.S. Denison & Co., and was a regular contributor to many of the leading American and European scientific journals at the time this book was first published.

INTRODUCTION

This section is presented in such a manner so that the novice, chemist or manufacturer will be able to read through the formulas in this book, and produce commodities in his kitchen or makeshift laboratory without an excessive amount of difficulty.

The formulas presented contain chemicals of a wide range: pigments, gums, resins, greases, waxes, emulsifying agents, dyestuffs, etc. To combine these ingredients into a reliable end-product requires careful study of the given procedure. Short cuts, chemical substitutions or deletions can result in complete failure or poor quality product. Follow directions precisely. Do not add A to B if B is specified to be added to A. In laboratory procedures A plus B is not always equal to B plus A as it is in mathematics, for it is the nature of the addition in the lab which determines the sum. Any experienced cook knows that in preparation of mayonnaise that if one adds the egg to the oil, one will get a mess, but that if one slowly adds the oil to the egg, stirring constantly, the result will be mayonnaise. The same holds true for the formulas presented in this book. Always use the specified grade of the chemical. If a cheaper end product is desired, don't look for cheap substitutions: use a different formula.

There is a limit to which this rule can be reasonably extended. In some cases successful substitutions can be made. When white beeswax is required yellow wax may be substituted (color not withstanding) but paraffin won't do, though its light color would lead one to think otherwise. One must experiment to achieve successful substitutions. As mentioned before, grade or type of a chemical must be followed precisely. Lanolin is not the same as anhydrous lanolin, and thus they are not interchangeable. If one is in doubt about a formula or a part of it, seek the help of a consultant or disgard the formula. Grades are specified on many chemicals. Use only those specified, and where none is given, understand that the best grade is to be used. In most cases a specific type of alcohol is referred to. When the general term alcohol is used, the experimenter should understand it to mean ethyl alcohol.

There are many terms and processes which one might find unfamiliar. They compose the language of chemistry. A glossary and an appendix is provided in this book to answer the most salient questions that the amateur chemist has with regard to terminology, processes and machinery.

Apparatus

In many instances you will not need anything more than the pots, glassware and china which are the normal equipment in every household. However, enameled pans are better than aluminum. For mixing emulsions, an electric mixer, blender or just plain egg beater will be satisfactory. For weighing, it might be worth your while to invest in a small scale from a laboratory supply house. Graduates and measuring glasses are found at drugstores. It would be best that you get a chemical thermometer from a laboratory supply house. Find out about the rental of, or purchase of, more specialized equipment for formulas that require it.

Heating

Always use a double boiler for heating liquids and dry materials when temperature called for is below 212°F. Be sure the pan does not go dry. To get uniform high temperature, use oil or grease in place of the water in the bottom of the double boiler. Stop heating if thick fumes are given off. They are flammable. Chemicals which melt uniformly, and are nonexplosive, may be heated directly over the flame. Use your thermometer to be sure you are working at the correct temperature.

Temperature Measurement

Both Fahrenheit and Centrigrade are used. The boiling point of water is 212°F. or 100°C. The melting point of ice is 32°F or 0°C. (See conversion tables in the appendix.)

Temperatures of liquids are measured by inserting a glass ther-

mometer as deep as possible into the liquid, but not against the side or bottom of the pan. Warm a cold thermometer (hold over surface of hot liquid) before immersion. Conversely a hot thermometer should not be placed on a cold surface. Sudden temperature change can crack the thermometer.

Mixing and Dissolving

This is accomplished easily by stirring and warming. For hand stirring, it is best to use a non-reactive material such as a glass rod.

Filtration

When undesirable particulate bodies are present in a liquid, they may be removed by settling (a centrifuge is an excellent device to speed up this process) or filtering.

The simplest way to achieve settling is to allow the solution to stand while the heavier than liquid particles sink to the bottom. Centrifuging speeds up this process by causing the denser particles to accelerate towards the end of the container because of the centrifugal force created by the machines spinning. In either case, when the particles have all collected at the bottom, the remaining liquid may be poured or siphoned off with care, and in some cases the liquid is then clean enough for use. If the particles cannot be removed by settling, they must be filtered out. Coarse or large bodies may be filtered through sterile muslin or cloth; if the particles are small, filter paper must be used. Filter papers are made in a wide range of fineness. Coarse paper will trap large particles but will let fine particles through; therefore, one must determine the fineness required to remove all particles. Sometimes these bodies are so small that no filter paper made is able to ensnare them; it is then necessary to add to the liquid 1 to 3 percent infusorial earth or magnesium carbonate. They aid the filter paper by clogging up its pores thus reducing their size and enabling them to hold back undissolved material of extreme fineness. In all such filtration, it is common practice to take the first portion of the filtered liquid and pour it through again.

Pulverizing and Grinding

Large masses are broken up by wrapping in a clean cloth, placing between two boards, and pounding with a hammer. This is repeated until the proper size is obtained. Fine grinding is done in a mortar and pestle.

Housekeeping

The manner in which you keep your materials will be reflected in your end products. Therefore, take care of them. Keep all containers tightly closed. This will prevent evaporation as well as contamination. Liquids should be kept in glass containers. They should be as

full as possible. Corks or stoppers should be covered with foil or dipped in paraffin. Glues, gums, oils and certain other products may ferment or become rancid. To prevent this, use suitable antiseptics or preservatives. Cleanliness is of utmost importance. Clean all containers thoroughly before use.

Where to Buy Chemical and Apparatus

Many chemicals and glassware can be bought from your druggist. A list of suppliers will be found in the Appendix. Make use of the yellow pages of your telephone directory. It will list local suppliers.

Caution

Some chemicals are poisonous and corrosive. Check the labels. Do not inhale them. If smelling is necessary, sniff a few inches from the stopper. Work in a well-ventilated room. If anything spills, wipe and wash immediately. (See the Appendix for safety rules for your laboratory.)

Units for Measurement

The formulas presented in this book contain proportions by weight, volume, or percentages by weight; some formulas use specific volumetric or mass units, such as cc's or grams etc. Different industries and various countries use a variety of systems of weights and measures. It is therefore, impossible for one set of units to satisfy everyone. Since the formulas in this book have diverse unitary measures, a set of conversion tables is provided in the appendix.

Several examples of types of formulas found in this book follows:

Example No. 1

Mastic Adhesive

	pts./wt.
Water	180
SBR 2002 Latex (48% T.S.)	352
Whiting	336
Titanium Dioxide (pigment)	5
"Carbopol" 934	5
Ammonium Hydroxide	to mucilage pH 9.5

Proc.: Disperse the "Carbopol" 934 in the water with moderate mixing and neutralize to pH9.5 with ammonium hydroxide. Slowly add the latex to this preneutralized "Carbopol" 934 mucilage with moderate mixing, such as with a blender. Add the pigment, very slowly, with moderate agitation, and stir until the product is smooth.

Upon choosing this formula to experiment with, one should begin by gathering the ingredients together. A list of suppliers for trademark products such as "Carbopol" 934 and general chemicals will be

found in the Appendix. The amounts of the ingredients to use are given in this formula in a weight ratio. You can decide to use grams, ounces, pounds, etc. But once you choose one of these, all the ingredients must be in this unit of measure. Because the amounts of the ingredients are given in a ratio, it is also possible for the experimenter to reduce the quantities proportionately. Thus, if one divides all the amounts in this formula by 5 the following values are obtained:

	pts./wt.
Water	36.0
SBR 2002 Latex (48% T. S.)	70.4
Whiting	67.2
Titanium Dioxide (pigment)	1.0
"Carbopol" 934	1.0
Ammonium Hydroxide	pH9.5

Now that the ingredients are established, the "Carbopol" 934 is added to the water. Using a pH meter or indicator, the pH of the solution is established. It will be less than 9.5. The ammonium hydroxide, which is a base, is used to bring the pH up to 9.5. This solution is put in a blender, and while mixing at a low speed, the latex is slowly added. The pigment is finally added to the mucilage, and the mixing continues until the product is smooth.

Example No. 2
Hair Lacquer (Non-Aerosol)

	pts./wt.
Refined (wax free) Bleached Shellac	15.00
Borax	3.45
Water	81.00

Proc.: Heat water to 145°F and add the borax. Add shellac, dissolving it at 145°F using a high speed stirrer. When the shellac is dissolved, cool and filter. Adjust pH with ammonia to about 8.5. This basic formula is compounded or reduced to the desired solids, to give either an all water hair lacquer, or water alcoholic hair sets.

Hair Lacquer Water Based Non-Aerosol

	pts./wt.
Basic Formula (see above)	80.0
Citroflex A-Z	1.0
Perfume	0.2

Water	18.8

Proc.: Mix all ingredients together.

Hair Lacquer Alcohol Water Based Non-Aerosol

	pts./wt.
Basic Formula (see above)	80.0
Citroflex A-Z	1.0
Perfume Oil	0.2
Alcohol#40	18.8

Proc.: Mix all ingredients together.

Here we have a base formula that is applied to two other formulas. The base formula is the Hair Lacquer (Non-Aerosol). The quantities of the ingredients are given in pts./wt. as in Example No. 1. Thus, the unit of measure of the materials is left up to the discretion of the experimenter.

The water is heated and a thermometer is used to determine when the temperature reaches 145°F. If your thermometer is in °C, use the conversion tables in the appendix to determine how many °C is equal to 145°F. Add the borax. Pour this solution into a blender and add the shellac. Turn on the blender and stir until the indredients are dissolved. After cooling the solution, take a piece of filter paper, fold it, and place it in a funnel. Place the funnel in a container. Pour the solution through the funnel lined with filter paper. Check the pH with a pH indicator or a pH meter. It will be below pH 8.5. The pH can be brought up to pH 8.5 using the base ammonia.

Now that the base for the hair lacquer has been formulated, it can be used in either the hair lacquer-water base formula, or the hair lacquer-alcohol water base formula.

Example No. 3
Nasal Drops

Menthol	2.5g.
Camphor	2.5g.
Eucalyptus Oil	6.0c.c.
Mucilage of Methyl Cellulose	6.0c.c.
Chloretone	5.0g.
Dextrose	45.0g.
Dist. Water q.s.	to 1000.00c.c.

Proc.: Liquify the menthol, camphor, and eucalyptus oil by trituration in a glass mortar. Add the mucilage under constant stirring until the oily drops disappear. Dissolve the dextrose and chloretone in the boiling water. When cool, mix the liquids, add water to make 1 liter and shake. Label: Shake well.

In this formula the exact units of measurement are given for each

ingredient. Since grams are a weight measurement and cc's are a volumetric measurement, any conversions of units of measure should be done with this in mind.

The menthol, camphor and eucalyptus oil are placed in a glass mortar. With a pestle these ingredients are rubbed and ground up into very fine particles. The mucilage is added, and the stirring and grinding with the pestle is continued. Part of the distilled water is placed in a pot or beaker and heated until it boils. The dextrose and chloretone are then stirred into the water. When they are dissolved and cooled, the mixture of menthol, camphor, eucalyptus oil and mucilage are added to the solution. The entire solution is then placed into a calibrated glass container and distilled water is added to make 1000.00 cc or I liter.

Asterisks noted in the text of the formulas refer the reader to the equipment section of the book. The asterisk denotes processes using pieces of equipment illustrated and described in this section.

ABBREVIATIONS

°Bé	Baume
B.P.	boiling point
°C	degrees Centigrade
cc	cubic centimeters
conc.	concentration
cp.	centipoises
ctsks.	centistokes
dil.	dilute
dr.	dram
°F	degrees Fahrenheit
fl. oz.	fluid ounce
g.	gram/s
gal.	gallon
gr.	grain
hr.	hour
kg.	kilogram
l.	liter
lb.	pound
liq.	liquid
min.	minute or minim
ml.	milliter
M.P.	melting point
oz.	ounce
%	per cent
pH	hydrogen ion concentration
ppm	parts per million
pt.	pint
pts.	parts
q.s.	quantity sufficient to make
qt.	quart
sec.	second
vol.	volume
wt.	weight

GLOSSARY

abrasive — a substance used for grinding, polishing, etc., as sandpaper or emery.

accelerator — a substance that speeds up a reaction.

agglomerate — to gather into a cluster, mass, or ball.

agitator — an apparatus for shaking or stirring, e.g. blender.

alkali — any of a large class of compounds which can react with an acid to form a salt and water. Alkalies are in the pH range of above 7 to 14. Common strong alkalies are sodium and potassium hydroxides, ammonium hydroxide, etc.

anionic — negatively charged (atoms).

anodyne — anything that relieves pain or soothes.

atomize — to reduce a liquid into a fine spray.

bacteriostatic — that property which arrests the growth and multiplication of bacteria.

balsam — any of various oily or gummy aromatic resins obtained from certain of a family (Balsaminaceae) of trees.

bleeding — running together as dyes in a wet cloth.

bung — a cork or other stopper for the hole in a barrel, cask, or keg.

cationic — positively charged (atoms).

centipoise — unit for measuring viscosity; is equal to 0.01 poise c.g.s. system; 1 poise = 1g/cm sec.

centistokes — a unit obtained by dividing the viscosity (in poises by the density (grams/cubic centimeters).

colloid — a substance made up of very small insoluble, nondiffusable particles that remain suspended in a surrounding medium of different matter.

colophony — rosin.

crutcher — mixing device used in making soap.

cure — time necessary for a plastic compound to remain in a mold for complete reaction so that it becomes solidified and chemically inactive.

deaeration — any process used to remove air from a substance.

decoction — an extract produced by boiling down.

deionized water — water that has gone through a purification process.

dermatitis — inflammation of the skin.

dilution — something that has been thinned down or weakened by mixing it with water or other liquid.

dispersion — a medium in which scattered particles are suspended.

distilled water — water which has been purified through the process of distillation.

drier — a substance used to accelerate the drying of paints, varnishes, printing inks, etc.

ebonize — to finish wood.

emulsion — a fluid such as milk, formed by the suspension of a very finely divided oily or resinous liquid in another liquid.

entrainment — the suspension (a liquid in the form of fine droplets) in a vapor, such that the vapor will carry the liquid away, as during distillation or evaporation.

ester — an organic compound formed by the reaction between an alcohol and an acid.

evaporation — the change of a substance from the solid or liquid phase to the gaseous or vapor phase.

exothermic — chemical reaction in which there is a liberation of heat, as in combustion.

filtrate — a filtered liquid.

filtration — mechanical separation of solids from a liquid by means of porous media.

fungistatic — a term used to describe certain fungicides that inhibit fungus growth but do not kill or destroy the fungus.

gel — a jellylike substance formed by the coagulation of a colloidal solution into a solid phase.

gill — a liquid measure equal to ¼ pint.

grout — a fine plaster used for finishing surfaces.

homogeneous — uniform in composition and structure.

homologue — one member of a series of compounds in which each member has a structure differing regularly by some increment (as a CH_2 group) from that of the adjacent members.

impregnated — filled or saturated; permeated with a substance.

lesion — an injury or other change in an organ or tissue of the body tending to result in impairment or loss of function.

levigate — to grind to a fine, smooth powder.

metol — a trademark for a white soluble powder, C_7H_9ON, used in its hydrosulfate as a photographic developer.

mesh — one of the small openings in a woven material, e.g. a 400 mesh sieve has 400 openings per linear inch.

micronize — to reduce to particles of only a few microns in diameter.

mill — piece of equipment used for grinding and crushing.

mucilage — any watery solution of gum, glue, etc.; used as an adhesive.

neutralization — chemical reaction between an acid and a base in such proportions that the characteristic properties of each disappear, e.g., $\underset{\text{(base)}}{NaOH} + \underset{\text{(acid)}}{HCl} \rightarrow \underset{\text{(salt)}}{NaCl} + \underset{\text{(water)}}{H_2O}$; the end products being a salt and water.

organic acid — compound containing the carboxyl group, $-\overset{\displaystyle O}{\overset{\|}{C}}-\overset{}{O}H$, e.g. acetic acid, CH_3COOH.

osmotic pressure — the force exerted by a solvent passing through a semipermeable membrane in osmosis, equal to the pressure that must be applied to the solution in order to prevent passage of the solvent into it.

pastille — a small tablet or lozenge containing medicine, flavoring, etc.

pectin — a water-soluble carbohydrate, obtained from certain ripe fruits, which yields a gel that is the basis of jellies and jams.

pH — scale for measuring the acidity or alkalinity of a solution. From zero to seven readings indicating respectively very acid to neutral and seven to fourteen indicating increasing alkalinity (basicity).

plasticizer — any of various substances added to a plastic material to keep it soft and viscous.

polymer — a naturally occurring or synthetic substance consisting of giant molecules formed from smaller molecules of the same substance and often having a definite arrangement of the components of the giant molecules.

polymerization — the process of joining two or more like molecules to form a more complex molecule whose molecular weight is a multiple of the original and whose physical properties are different.

potency — having effectiveness or power in action, as a drug.

preservative — a substance that is added to a food to keep it from spoiling.

quaternary — designating a compound containing four different elements.

reagents – Any substance used in a reaction for the purpose of measuring, examining, detecting or analyzing other substances.

reduction – a chemical reaction in which hydrogen combines with another substance or in which oxygen is removed from a substance more generally, a chemical change in which the valence state of an atom of an element is decreased, due to gain of one or more electrons.

refluxing – continuous return of condensed vapor to the boiling liquid by the use of suitable apparatus.

residue – the matter remaining at the end of a process, as after evaporation, combustion, filtration, etc.; residual product.

saponification – a process by which an ester heated with an alkali (such as NaOH) reacts to form an alcohol and acid salt; this process produces soap.

saturation – process by which the maximum amount of gas, liquid, or solid is dissolved in a solution at a given temperature and pressure.

sequestering agent – added material in a solution that produces a stable, soluble complex.

shear (shearing force or stress) – the action or force causing two contacting parts or layers (liquid or solid) to slide upon each other moving in opposite directions parallel to their plane of contact.

slurry – a thin watery suspension; also a stream of pulverized metal ore.

solubilize – to render a substance soluble.

solution – a uniformly dispersed mixture, at the molecular or ionic level, of one or more substances (solute) in one or more other substances (the solvent).

solvent – a substance capable of dissolving another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular or ionic size level.

specific gravity – the ratio between the weight of a given volume of any substance with the weight of an equal volume of water.

stabilizer – any substance which tends to keep a compound, mixture, or solution from changing its form or nature. Stabilizers may retard a reaction rate, preserve a chemical equilibrium, act as antioxidants, keep pigments and other components in emulsion form, or prevent the particles in colloidal suspension from precipitating.

supernatant — a liquid or fluid forming a layer on the surface of a solid or another liquid.

surfactant — any substance, such as a detergent, wetting agent, etc., that lowers the surface tension of the solvent in which it is dissolved.

suspension — a liquid having small solid or semisolid particles more or less uniformly dispersed through it. If the particles are small enough to pass through ordinary filters and do not settle out on standing, the suspension is called a colloidal suspension or solution.

therapeutic — serving to preserve health.

thixotropic — a gel or emulsion that has the property of becoming fluid when agitated and then setting again when left at rest.

titer, titre — standard of strength of a solution, as determined by the titration.

tung oil — a fast drying oil derived from the seeds of the tung tree, used in place of linseed oil in paints, varnishes, etc., for a more water resistant finish.

vehicle — a liquid such as water or oil, with which pigments are mixed for use.

viscosity — the internal friction of a fluid caused by molecular attraction, which makes it resist the tendency to flow.

volatile matter — gaseous products, except moisture, given off by a material.

wetting out — wetting or covering a surface completely; penetrating thoroughly.

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