The Chemical Formulary

Collection of commercial Formulas
for Making Thousands fo Products
in Many Fields

VOLUME XXXI

Editor-in-Chief

H. BENNETT, F.A.I.C. (deceased)

CHEMICAL PUBLISHING COMPANY, INC.

New York 1993

The Chemical Formulary, Volume XXXI

ISBN: 978-0-8206-0343-8

Chemical Publishing Company:
www.chemical-publishing.com
www.chemicalpublishing.net

First Edition:

© **Chemical Publishing Company, Inc. -** New York 1993-2011

Second Impression:

Chemical Publishing Company, Inc. - 2011

Printed in the United States of America

CONTRIBUTORS

Air Products & Chemicals Inc.
7201 Hamilton Blvd.
Allentown, PA 18195

Akzo Chemicals Inc.
300 South Riverside Plaza
Chicago, IL 60606

The Amerchol Corp.
136 Talmadge Road
Edison, NJ 08818

American Colloids Co.
P.O. Box 160
Belle Fourche, SD 57717

American Lecithin Co.
33 Turner Road
Danbury, CT. 06813

Angus Chemical Co.
1500 E. Lake Cook Road
Buffalo Grove, IL 60089

Croda Inc.
180 Northfield Ave.
Edison, NJ 08837

Gattefosse s.a.
36, chemin de Genas
F-69804 Saint-Priest Cedex, France

Grain Processing Corp.
1600 Oregon St.
Muscatine, IA 52761

Huntington H&S Chemicals Div.
970 E. Tipton
Huntington, IN 46750

McIntyre Group Ltd.
1000 Governors Highway
University Park, IL 60466

Mona Industries Inc.
76 E. 24 Street
Paterson, NJ 07544

NYCO Minerals Inc.
Mt. View Drive
Willsboro, NY 12996

Pilot Chemical Co.
11756 Burke St.
Santa Fe Springs, CA 90670

Frank B. Ross Co., Inc.
22 Halladay Street
Jersey City, NJ 07304

Stepan Company
Edens & Winnetka Roads
Northfield, IL 60093

Zschimmer & Schwarz Gmbh & Co.
Max-Schwarz-Str. 3-5
W-5420 Lahnstein, Germany

CONTENTS

PREFACE

Chemistry, as taught in our schools and colleges, concerns chiefly synthesis, analysis, and engineering—and properly so. It is part of the right foundation for the education of the chemist.

Many a chemist entering an industry soon finds that most of the products manufactured by his concern are not synthetic or definite chemical compounds, but are mixtures, blends, or highly complex compounds of which he knows little or nothing. The literature in this field, if any, may be meager, scattered, or obsolete.

Even chemists with years of experience in one or more industries spend considerable time and effort in acquainting themselves with any new field which they may enter. Consulting chemists similarly have to solve problems brought to them from industries foreign to them. There was a definite need for an up-to-date compilation of formulas for chemical compounding and treatment. Since the fields to be covered are many and varied, an editorial board of chemists and engineers engaged in many industries was formed.

Many publications, laboratories, manufacturing firms, and individuals have been consulted to obtain the latest and best information. It is felt that the formulas given in this volume will save chemists and allied workers much time and effort.

Manufacturers and sellers of chemicals will find, in these formulas, new uses for their products. Nonchemical executives, professional men, and interested laymen will make through this volume a "speaking acquaintance" with products which they may be using, trying, or selling.

It often happens that two individuals using the same ingredients in the same formula get different results. This may be due to slight deviations in the raw materials or unfamiliarity with the intricacies of a new technique. Accordingly, repeated experiments may be necessary to get the best results. Although many of the formulas given are being used commercially, many have been taken from the literature and may be subject to various errors and omissions. This should be taken into consideration. Wherever possible, it

is advisable to consult with other chemists or technical workers regarding commercial production. This will save time and money and help avoid trouble.

A formula will seldom give exactly the results which one requires. Formulas are useful as starting points from which to work out one's ideas. Also, formulas very often give us ideas which may help us in our specific problems. In a compilation of this kind, errors of omission, commission, and printing may occur. I shall be glad to receive any constructive criticism.

H. BENNETT

PREFACE TO VOLUME XXXI

In 1990 we lost our oldest and most prestigious author and friend, Harry Bennett at age 95. He is sorely missed.

It was his wish that the "FORMULARY" continue with or without him. Our editorial staff has put together this volume XXXI, and shall continue to do so without making any changes in style or presentation.

This new volume of the CHEMICAL FORMULARY series is a collection of new, up-to-date formulas. the only repetitious material is the introduction (Chapter I) which is used in every volume for the benefit of those who may have bought only one volume and who have no educational background or experience in chemical compounding. the simple basic formulas and compounding methods given in the introduction will serve as a guide for beginners and students. It is suggested that they read the introduction carefully and even make a few preparations described there before compounding the more intricate formulas included in the later chapters.

The list of chemicals and their suppliers has been enlarged with new trademark chemicals. All tradename chemicals appear in the formulas in boldface and these tradenames are listed alphabetically in the appendix followed by a list of corresponding manufacturers. thus buying the required ingrdients will present no problem.

Grateful acknowledgement is made to the Contributors for their valuable suggestions and contributions, which allows us to continue this series.

CHEMICAL PUBLISHING CO., INC.

NOTE: All the formulas in Volumes I through XXXI (except in the Introduction) are different. thus, if you do not find what you want in this volume, you may find it in one of the other.

NOTE: This book is the result of cooperation of many chemists and engineers who have given freely of their time and knowledge. It is their business to act as consultants and to give advice on technical matters for a fee. As publishers, we do not maintain a laboratory or consulting service to compete with them. Therefore, please do not ask for advice or opinions, but consult a chemist.

BOOKS BY H. BENNETT

Bennett's Cosmetic Formulary
The Chemical Formulary Vols. I-XXXI
The Cumulative Index Vols. I-XXV-The Chemical Formulary
Concise Chemical & Technical Dictionary
New Cosmetic Formulary
Chemical Specialties
Indusrial Waxes, Vols. I, II
Practical Emulsions, Vols. I, II
More For Your Money
Encyclopedia of Chemical Trademarks and Synonyms, Vols. I-III

ABBREVIATIONS

act. ..... active, activity
AM ..... active matter
amp ..... ampere(s)
anhyd ..... anhydrous
approx. ..... approximately
aq. ..... aqueous
ASTM ..... American Society for Testing and Materials
avoir ..... avoirdupois
Bé ..... Baumé
B.P. ..... boiling point
°C ..... degrees Centigrade
cc ..... cubic centimeter(s)
cm ..... centimeter(s)
cm^3 ..... cubic centimeter(s)
conc ..... concentrated, concentration
c.p. ..... chemically pure
cp, cP, cps ..... centipoise(s)
cs ..... centistoke(s)
cu ft ..... cubic foot
cu in. ..... cubic inch
cwt ..... hundredweight
dil ..... dilute
dm ..... decimeter(s)
dr ..... dram(s)
°F ..... degrees Fahrenheit
fl ..... fluid
fl dr ..... fluid dram(s)
fl oz ..... fluid ounce(s)
F.P. ..... freezing point
ft ..... foot
ft^2 ..... square foot
ft^3 ..... cubic foot
g ..... gram(s)
gal ..... gallon(s)
gr ..... grain(s)
h ..... hour(s)
hl ..... hectoliter(s)
in. ..... inch(es)
$in.^3$ ..... cubic inch(es)
K.U. ..... Krebs units
kg ..... kilogram(s)
l ..... liter(s)
lb ..... pound(s)
liq ..... liquid

ABBREVIATIONS

m	milli or meter(s)
MIL	Military specifications
min	minimum, minute
ml	milliliter(s)
mm	millimeter(s)
M.P.	melting point
MPa	mega pascal
N	newton or Normal
N.F.	National Formulary
NV	nonvolatiles
o/w	oil-in-water
oz	ounce(s)
P/B	pigment/binder
Pa	pascal
pH	hydrogen-ion concentration
phr	parts per hundred rubber
pkg.	package
ppm	parts per million
psi	pounds per square inch
psig	pounds per square inch gauge
pt	pint(s)
PVC	pigment volume concentration
pwt	pennyweight
q.s.	a quantity sufficient to make
qt	quart
®	registered trademark
R.T.	room temperature
rpm	revolutions per minute
s	second(s)
sol'n.	solution
Sp. Gr.	specific gravity
T.P.	triple pressed
tbsp.	tablespoon(s)
tech	technical
tinc	tincture
™	trademark
tsp	teaspoon(s)
USP	United States Pharmacopeia
UV	ultraviolet
V	volt(s)
visc	viscosity
vol	volume
w/o	water-in-oil
wt	weight

Chapter I

INTRODUCTION

The following introductory matter has been included at the suggestion of teachers of chemistry and home economics.

This section will enable anyone, with or without technical education or experience, to start making simple products without any complicated or expensive machinery. For commercial production, however, suitable equipment is necessary

Chemical specialties are composed of pigments, gums, resins, solvents, oils, greases, fats, waxes, emulsifying agents, dyestuffs, perfumes, water, and chemicals of great diversity. To compound certain of these with some of the others requires definite and well studied procedures, any departure from which will inevitably result in failure. The steps for successful compounding are given with the formulas. Follow them rigorously. If the directions require that (*a*) is added to (*b*), carry this out literally, and do not reverse the order. The preparation of an emulsion is often quite as tricky as the making of mayonnaise. In making mayonnaise, you add the oil to the egg, slowly, with constant and even stirring. If you do it correctly, you get mayonnaise. If you depart from any of these details: if you add the egg to the oil, or pour the oil in too quickly, or fail to stir regularly, the result is a complete disappointment. The same disappointment may be expected if the prescribed procedure of any other formulation is violated.

The point next in importance is the scrupulous use of the proper ingredients. Substitutions are sure to result in inferior quality, if not in complete failure. Use what the formula calls for. If a cheaper product is desired, do not prepare it by substituting a cheaper ingredient for the one prescribed: use a different formula. Not infrequently, a formula will call for an ingredient which is difficult to obtain. In such cases, either reject the formula or substitute a similar substance only after a preliminary experiment demonstrates its usability. There is a limit to which this rule may reasonably be extended. In some cases, substitution of an equivalent ingredient may be

made legitimately. For example, when the formula calls for white wax (beeswax), yellow wax can be used, if the color of the finished product is a matter of secondary importance. Yellow beeswax can often replace white beeswax making due allowance for color, but paraffin wax will not replace beeswax, even though its light color seems to place it above yellow beeswax.

This leads to the third point: the use of good-quality ingredients, and ingredients of the correct quality. Ordinary lanolin is not the same thing as anhydrous lanolin. The replacement of one with the other, weight for weight, will give discouragingly different results. Use exactly what the formula calls for: if you are not acquainted with the substance and you are in doubt as to just what is meant, discard the formula and use one you understand. Buy your chemicals from reliable sources. Many ingredients are obtainable in a number of different grades: if the formula does not designate the grade, it is understood that the best grade is to be used. Remember that a formula and the directions can tell you only part of the story. Some skill is often required to attain success. Practice with a small batch in such cases until you are sure of your technique. Many examples can be cited. If the formula calls for steeping quince seed for 30 min in cold water, steeping for 1 h may yield a mucilage of too thin a consistency. The originator of the formula may have used a fresher grade of seed, or his conception of what "cold" water means may be different from yours. You should have a feeling for the right degree of mucilaginousness, and if steeping the seed for 30 min fails to produce it, steep them longer until you get the right kind of mucilage. If you do not know what the right kind is, you will have to experiment until you find out. This is the reason for the recommendation to make small experimental batches until successful results are obtained. Another case is the use of dyestuffs for coloring lotions and the like. Dyes vary in strength; they are all very powerful in tinting value; it is not always easy to state in quantitative terms how much to use. You must establish the quantity by carefully adding minute quantities until you have the desired tint. Gum tragacanth is one of those products which can give much trouble. It varies widely in solubility and bodying power; the quantity listed in the formula may be entirely unsuitable for your grade of tragacanth. Therefore, correction is necessary, which can be made only after experiments with the available gum.

In short, if you are completely inexperienced, you can profit greatly by experimenting. Such products as mouthwashes, hair tonics, and astringent lotions need little or no experience, because they are, as a rule, merely mixtures of simple liquid and solid ingredients, which dissolve without difficulty and the end product is a clear solution that is ready for use when

mixed. However, face creams, toothpastes, lubricating greases, wax polishes, etc., whose formulation requires relatively elaborate procedures and which must have a definite final viscosity, need some skill and not infrequently some experience.

FIGURING

Some prefer proportions expressed by weight or volume, others use percentages. In different industries and foreign countries different systems of weights and measures are used. For this reason, no one set of units could be satisfactory for everyone. Thus diverse formulas appear with different units, in accordance with their sources of origin. In some cases, parts are given instead of percentage or weight or volume. On the pages preceding the index, conversion tables of weights and measures are listed. These are used for changing from one system to another. The following examples illustrate typical units.

Example No. 1

Ink for Marking Glass

Glycerin	40	Ammonium Sulfate	10
Barium Sulfate	15	Oxalic Acid	8
Ammonium Bifluoride	15	Water	12

Here no units are mentioned. In this case, it is standard practice to use parts by weight throughout. Thus here we may use ounces, grams, pounds, or kilograms as desired. But if ounces are used for one item, the ounce must be the unit for all the other items in the formula.

Example No. 2

Flexible Glue

Powdered Glue	30.90%	Glycerin	5.15%
Sorbitol (85%)	15.45%	Water	48.50%

Where no units of weight or volume, but percentages are given, forget the percentages and use the same method as given in Example No. 1.

Example No. 3

Antiseptic Ointment

Petrolatum	16 parts	Benzoic Acid	1 part
Coconut Oil	12 parts	Chlorothymol	1 part
Salicylic Acid	1 parts		

The instructions given for Example No. 1 also apply to Example No. 3. In many cases, it is not wise to make up too large a quantity of a product before making a number of small batches to first master the necessary technique and also to see whether the product is suitable for the particular purpose for which it is intended. Since, in many cases, a formula may be given in proportions as made up on a factory scale, it is advisable to reduce the quantities proportionately.

Example No. 4

Neutral Cleansing Cream

Mineral Oil	80 lb	Water	90 lb
Spermaceti	30 lb	Glycerin	10 lb
Glyceryl Monostearate	24 lb	Perfume	To suit

Here, instead of pounds, ounces or even grams may be used. This formula would then read:

Mineral Oil	80 g	Water	90 g
Spermaceti	30 g	Glycerin	10 g
Glyceryl Monostearate	24 g	Perfume	To suit

Reduction in bulk may also be obtained by taking the same fractional part of portion of each ingredient in a formula. Thus in the following formula:

Example No. 5

Vinegar Face Lotion

Acetic Acid (80%)	20	Alcohol	440
Glycerin	20	Water	500
Perfume	20		

We can divide each amount by ten and then the finished bulk will be only one tenth of the original formula. Thus it becomes:

Acetic Acid (80%)	2	Alcohol	44
Glycerin	2	Water	50
Perfume	2		

APPARATUS

For most preparations, pots, pans, china, and glassware, which are used in every household, will be satisfactory. For making fine mixtures and emulsions, a malted-milk mixer or egg beater is necessary. For weighing, a small, low-priced scale should be purchased from a laboratory-supply house. For measuring fluids, glass graduates or measuring glasses may be purchased from your local druggist. Where a thermometer is necessary, a chemical thermometer should be obtained from a druggist or chemical-supply firm.

METHODS

To understand better the products which you intend to make, it is advisable that you read the complete section covering such products. You may learn different methods that may be used and also to avoid errors which many beginners are prone to make.

CONTAINERS FOR COMPOUNDING

Where discoloration or contamination is to be avoided, as in light-colored, or food and drug products, it is best to use enameled or earthenware vessels. Aluminum is also highly desirable in such cases, but it should not be used with alkalis as these dissolve and corrode aluminum.

HEATING

To avoid overheating, it is advisable to use a double boiler when temperatures below 212 F (temperature of boiling water) will suffice. If a double boiler is not at hand, any pot may be filled with water and the vessel containing

the ingredients to be heated placed in the water. The pot may then be heated by any flame without fear of overheating. The water in the pot, however, should be replenished from time to time; it must not be allowed to "go dry." To get uniform higher temperatures, oil, grease, or wax is used in the outer container in place of water. Here, of course, care must be taken to stop heating when thick fumes are given off as these are inflammable. When higher uniform temperatures are necessary, molten lead may be used as a heating medium. Of course, with chemicals which melt uniformly and are nonexplosive, direct heating over an open flame is permissible, with stirring, if necessary.

Where instructions indicate working at a certain temperature, it is important to attain the proper temperature not by guesswork, but by the use of a thermometer. Deviations from indicated temperatures will usually result in spoiled preparations.

TEMPERATURE MEASUREMENT

In the United States and in Great Britain, the Fahrenheit scale of temperature is used. The temperature of boiling water is 212 Fahrenheit (212 F); the temperature of melting ice is 32 Fahrenheit (32 F).

In scientific work, and in most foreign countries, the Centigrade scale is used, on which the temperature of boiling water is 100 Centigrade (100 C) and the temperature of melting ice is 0 Centigrade (0 C).

The temperature of liquids is measured by a glass thermometer. This is inserted as deeply as possible in the liquid and is moved about until the temperature reading remains steady. It takes a short time for the glass of the thermometer to reach the temperature of the liquid. The thermometer should not be placed against the bottom or side of the container, but near the center of the liquid in the vessel. Since the glass of the thermometer bulb is very thin, it breaks easily when striking it against any hard surface. A cold thermometer should be warmed gradually (by holding it over the surface of a hot liquid) before immersion. Similarly the hot thermometer when taken out of the liquid should not be put into cold water suddenly. A sharp change in temperature will often crack the glass.

MIXING AND DISSOLVING

Ordinary dissolution (e.g., that of sugar in water) is hastened by stirring and warming. Where the ingredients are not corrosive, a clean stick, a fork,

INDEX

N

O

P

R

S