spectrum®
PHARMACY PRODUCTS

## January 2017

## Percentages [1]

Concentrations expressed as percentage are calculated and expressed many ways.

- Volume-volume (v/v) percentages indicate the volume of solute per volume of solution.
- Weight-weight (w/w) percentages express the concentration as the weight of solute in the weight of solute-solution mixture.
- Weight-volume (w/v) concentrations are calculated by the weight of the solute per volume of solution.

*EXAMPLE*
*Using the weight-weight percent concentration, calculate the following. What is the percentage concentration (w/w) in a solution containing phenol 2.50 gm in 10.00 gm of glycerin?*

Equation: $$\left(\frac{\text{w}}{\text{w}}\%\right) = \frac{\text{weight of solute}}{\text{weight of solute} + \text{weight of diluent}} \text{ x } 100$$

$$\left(\frac{w}{w}\%\right) = \frac{2.50\ gm}{2.50\ gm + 10.0\ gm}\ x\ 100$$

$$\left(\frac{w}{w}\%\right) = 20.00\%$$

## February 2017

## Percentages versus mg/mL or mg/g [1]

Percentages (w/w and w/v) are frequently used to express the concentration of active ingredients.
Percentages are used for:
• topicals (e.g. creams, ointments and pastes)
• injections
• anesthetics
• irrigations
• nebulizing solutions
• ophthalmics
• acids

Concentrations expressed as milligrams per milliliter (mg/mL) or milligrams per gram (mg/g) are more commonly used in:
• oral suspensions or solutions
• injections
• (and sometimes) ophthalmics

One simple way to convert a percent concentration to a mg/mL or mg/g expression is to move the decimal place in the figure one place to the right.

EXAMPLES: Phenylephrine solution at 1.5% contains 15 mg/mL of the active ingredient
Mupirocin 2% contains 20 mg/g of the active ingredient

When labeling compounded medication, utilizing both expressions can often eliminate confusion. The added step of including the mg/mL expression simplifies dosing calculations for physicians and nurses.

EXAMPLE:
A label for Bupivacaine injection should be labeled as 0.25% (2.5 mg/mL)

## March 2017

## Ratios [1]

A ratio defines the concentration of the parts of an active ingredient compared to the parts of the total mixture. Many active ingredients are required in doses so small that accurate measurement of the ingredient for an individual compound is nearly impossible. To permit accurate measurement, a proportional dilution or aliquot can be prepared utilizing ratios.

*EXAMPLE 1:*
*A common aliquot in pharmacy compounding is Levothyroxine (or T4). With a proportional dilution, a weighable quantity of Levothyroxine can be properly mixed in a diluent powder. As a result, the correct dosage for an individual compound becomes weighable.*

*EXAMPLE 2:*
*The concentration of Epinephrine in injection form (and other injectable anesthetic combinations) is typically expressed as a ratio – for example 1:1,000.*

*What is the concentration of Epinephrine Injection in mg per mL in a 1:1,000 ratio?*

*Based on the ratio, we know that there is 1g (or one part) of Epinephrine in 1000 mL (1000 parts) of solution. Therefore, to calculate how many milligrams are in 1 mL we can solve for x using the following relationship:*

$$\frac{1\ g}{1000\ mL} = \frac{x\ g}{1\ mL}$$

*Solving for x:* *x = 0.001 gm [in 1 mL]*

$$= \left(\frac{0.001\ gm}{1\ mL}\right) x \left(\frac{1000\ mg}{1\ gm}\right) = 1\frac{mg}{mL}$$

*Convert mg/mL to a percent:*
Reverse the "simple conversion" (From February calculations) → move the decimal place in the figure one place to the left.

*Therefore, a 1:1,000 concentration is equivalent to: 1 mg/mL or 0.1%*

## April 2017

## Milliequivalents [1]

Milliequivalents are related to the total number of ionic charges in solution according to the valence of the ions. Common applications include:

- Clinicians expressing the concentration of electrolytes in solution *(e.g. TPN, $K^+$ oral solutions)*
- Use in blood plasma laboratory reports
- Physicians / veterinarians ordering electrolyte supplements expressed in mEq per dose or per mL

Understanding the calculation of millequivalent concentrations is an important skill to master in pharmacy compounding.

<u>Equations:</u>

$$\text{Equivalent weight} = \frac{\text{molecular weight}}{\text{valence}}$$

mEq = one thousandth of an equivalent
(the weight of a substance that supplies one unit of charge)

*EXAMPLE 1:*
*A veterinarian orders a Potassium Chloride 10 mEq/mL, 200 mL oral solution. How many grams of Potassium Chloride are needed to compound the solution?*

*Obtain from references:*
*Valence of KCl = 1*
*molecular weight of KCl = 74.5 gm/mole*

Use the values to calculate the Equivalent weight:

$$\text{Equivalent weight} = \frac{\text{MW}}{\text{valence}} = \frac{74.5\ gm}{1} = 74.5\ gm$$

Then calculate the mEq:

$$\text{mEq} = \frac{\text{equivalent weight}}{1000} = \frac{74.5\ gm}{1000} = 0.0745\ gm\ (or\ 74.5\ mg)$$

*The medication order is for 10mEq/mL, 200 mL oral solution.*
*So:*

$$\frac{10\ mEq}{ml}\ x\ 200\ ml = 2{,}000\ mEq\ total\ in\ the\ solution$$

Use the mEq value to calculate the grams of API:

$$\frac{2{,}000\ mEq}{total\ \ solution}\ x\ \frac{0.0745\ gm\ KCl}{mEq} = \frac{149\ gm\ KCl}{total\ \ solution}$$

*EXAMPLE 2:*
*A solution contains 10 gm/100 mL (10%) Calcium chloride, Dihydrate. Express the concentration of Calcium in milliequivalents per mL (mEq/mL).*

*Obtain from references:*

*Valence of $CaCl_2$ Dihydrate = 2*

*Molecular weight of $CaCl_2$ Dihydrate = 147.01 gm/mole*

Use the values to calculate the Equivalent weight:

$$\text{Equivalent weight} = \frac{\text{MW}}{\text{valence}} = \frac{147.01\ gm}{2} = 73.5\ gm$$

Then calculate the mEq:

$$\text{mEq} = \frac{\text{equivalent weight}}{1000} = \frac{73.5\ gm}{1000} = 0.0735\ gm\ (or\ 73.5\ mg)$$

*The concentration of the solution is:*

$$\frac{10\ gm}{100\ mL} = \frac{0.1\ gm}{mL}$$

*Converting to mg:*

$$\frac{0.1\ gm}{mL}\ x\ \frac{1000\ mg}{1\ gm} = \frac{100\ mg}{mL}$$

Use the mEq value to calculate the concentration in mEq/mL:

$$\frac{1\ mEq}{73.5\ mg}\ x\ \frac{100\ mg}{mL} = \frac{1.36\ mEq}{mL}$$

# May 2017

## Normal Solutions [3]

Normal solutions are frequently used in acid-base chemistry and for adjustment of pH in certain formulations. Using a standardized normal concentration can take the guess-work out of pH adjustment and solution chemistry.

The normality of a solution expresses the number of equivalents of solute in one liter of solution (Eq/L).

The number of equivalents of a substance is determined by its valence in the molecule, or in the reaction in which it is taking part.

The equivalent weight is determined by its gram-molecular weight divided by the total valence of the ion.

To calculate the normality of a solution use the following equations:

$$\text{Equivalent Weight (EW)} = \frac{\text{Molecular Weight}}{\text{valence}}$$

$$\text{Normality} = \frac{\text{equivalents of solute}}{\text{liter of solvent}} = \frac{\text{grams of solute}}{\text{volume of solvent (L) x EW}}$$



*EXAMPLE 1:*
*What is the Normality of 1 gm NaCl dissolved in 0.05 L of water?*

*Obtain from references:*

*MW of NaCl = 58.443 gm/mole*
*Valence of NaCl = 1*

$$EW = \frac{\frac{58.443\ gm}{mole}}{1} = \frac{58.443\ gm}{mole}\ x\ 1 = \frac{58.443\ gm}{mole}$$

Consider: MW (gm) = 1 mole

1 mole = 1 Eq

$$= \frac{58.443\ gm}{mole}\ x\ \frac{1\ mole}{1\ Eq} = \frac{58.443\ gm}{Eq}$$

$$Normality = \frac{[(1\ gm)]}{\left[\left[(0.05\ L)\left(\frac{58.443\ gm}{Eq}\right)\right]\right]} = \frac{1\ gm}{1}\ x\ \frac{1}{0.05\ L}\ x\ \frac{1\ Eq}{58.443\ gm} = \frac{0.342\ Eq}{L} = 0.342\ N$$

*EXAMPLE 2:*

*How many mL of 37.5% (w/w) Hydrochloric acid are needed to prepare 250 mL of a 0.1 N solution?*

*Obtain from references:*

*MW HCl = 36.46 gm/mole*
*Specific gravity HCl = 1.18*
*Valence of HCl = 1*

Calculate the number of equivalents in the preparation:

$$\text{Normality} = \frac{\text{equivalents of solute}}{\text{liter of solvent}}$$

$$\text{Equivalents of solute} = \text{Normality} \ \text{x} \ \text{liter of solvent}$$

$$= 0.1\,N \ x \ 0.250\,L \ = \ 0.025\,Equivalents$$

Calculate the Equivalent weight (EW):

$$\text{EW} = \frac{\text{MW}}{\text{valence}} = \frac{36.46\ gm\ HCl}{1} = \frac{36.46\ gm\ HCl}{Equivalents}$$

Calculate the grams needed (by equivalence):



$$\text{grams} = \text{equivalents} \ \text{x} \ \text{EW}$$

$$gm\ of\ HCl = 0.025\ equivalents\ x\ \frac{36.46\ gm\ HCl}{equivalents}$$

$$= 0.9115\ gm\ HCl$$

Calculate the weight required to make the final solution:

$$\text{weight} = \frac{\text{grams}}{\text{concentration} \quad (\%\frac{\text{w}}{\text{w}})}$$

$$= \frac{0.9115\,gm\ HCl}{\left[\left(\frac{37.5gm}{100\,gm}\right)HCl\right]} = 0.9115\ gm\ HCl\ \ x\ \left(\frac{100\ gm}{37.5\ gm}\right)HCl = 2.43\ gm\ HCl$$

Use Specific Gravity value to express the weight in an equivalent volumetric value.

$$\text{volume} = \frac{\text{weight HCl}}{\text{specific gravity}}$$

$$= \frac{2.43\ gm}{1.18} = 2.059\ gm = 2.06\ mL$$

## June 2017

## Dilution and Concentration [1]

A frequent method of preparing solutions, ointments, creams and powders is to dilute a concentrated formula. Because the amount of drug *(or solute)* in the total weight of the diluted formula will be the same as that of the concentrate, we can use the following relationship:

(Initial quantity)(Initial concentration) = (Final quantity)(Final concentration)

Symbolically: $(Q_1)(C_1) = (Q_2)(C_2)$

Some hints to help prevent errors in solving dilution problems:

- Initial concentration must be larger than final concentration.
- Initial weight (volume) must be less than final weight (volume).
- Final weight (volume) minus initial weight (volume) equals amount of diluent (inert substance) to be added to make the final volume.

*EXAMPLE:*
*How much ointment base must be added to 60 gm of a 10% (w/w) ointment to compound an ointment with a 5% (w/w) concentration?*

Substituting the values into the equation above:

$$(60\ gm)(10\%) = (Q_2)(5\%)$$

$$6\ gm = (Q_2)(5\%)$$

$$Q_2 = \frac{6gm}{0.05}$$

$$Q_2 = 120\ gm$$

*Subtracting the weight of the 10% cream ($Q_1$) from the total ($Q_2$), yields the final answer:*

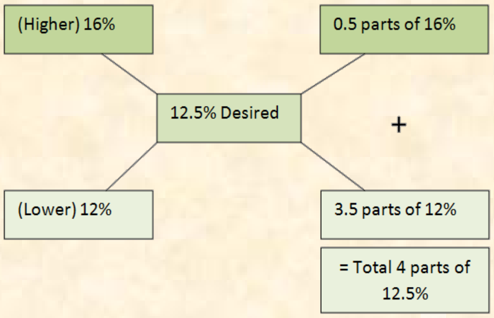
$$120\ gm - 60\ gm = 60\ gm \text{ of ointment base}$$

## July 2017

# Alligation [1]

Alligation is a method of calculating the required proportion of two similar preparations of different strengths, that when combined will yield a preparation of intermediate strength.

*EXAMPLE: Prepare 1000 gm of an ointment with 12.5% of an active ingredient. Combine a 16% formulation with a 12% formulation using the following calculation:*






Determine the number of parts of each formula to measure by subtracting the desired concentration from both the higher and lower concentrations.

*In this example, we need 0.5 parts of the 16% formula and 3.5 parts of the 12% formula. Adding 0.5 parts and 3.5 parts, a total of 4 parts will make up the total quantity of the final compound.*

*To make 1000 gm:* $\frac{1000\ gm}{preparation} \ x \ \frac{preparation}{4\ parts} = \frac{250\ gm}{part}$

*Then calculate the quantity of each for the final formulation:*

$$3.5\ parts\ of\ 12\% \ x \ \frac{250\ gm}{part} = 875\ gm\ of\ 12\%$$

$$0.5\ parts\ of\ 16\% \ x \ \frac{250\ gm}{part} = 125\ gm\ of\ 16\%$$

## August 2017

## Base versus Salts or Esters [1]

Many active pharmaceutical ingredients and excipients are in salt or ester form. In many cases the use of a salt or ester is beneficial to the formula.

For example, the hydrochloride salts of Phenylephrine and Epinephrine improve the solubility of the drug. And, unlike Metronidazole base which is very bitter in taste, Metronidazole Benzoate is essentially tasteless and can be used in oral suspensions and animal treats.

It is essential to check USP monographs or other available sources to determine dosing of the given drug. Dosages and concentrations of some active ingredients are calculated according to the base, and others on the salt form. Unless the relationship between the weight of the base and the weight of the salt or ester is accounted for, a compound may be prepared subpotent.

For instance, while the concentration of the active ingredient in Testosterone Cypionate is based on the Cypionate salt, Dexamethasone Sodium Phosphate injection concentration is based solely on Dexamethasone Phosphate.

In the case of a salt or ester we can use the following equation to calculate the quantity of that salt or ester to measure:

$$wt\ of\ salt\ or\ ester = \frac{prescribed\ dose\ \ x\ \ MW\ of\ salt}{MW\ of\ base}$$

*EXAMPLE:*
*What weight of Metronidazole Benzoate is needed to deliver a dose of 100 mg Metronidazole?*
*From references: Metronidazole Benzoate MW = 275.30 gm/mole*
*Metronidazole MW = 171.15 gm/mole*

$$wt.\ of\ metronidazole\ benzoate = \frac{100\ mg\ \ x\ \ 275.30\left(\frac{gm}{mole}\right)}{171.15\left(\frac{gm}{mole}\right)} = 160.85\ mg\ (or\ 161\ mg)$$

## September 2017

## Loss on Drying [1]

Depending on the relative humidity of storage conditions, many compounding chemicals take on moisture. Loss on drying is a widely used test method to determine the moisture content of a sample material. In order to properly calculate the quantity of active pharmaceutical ingredients (or excipients) to measure, moisture content, or loss on drying, must be considered. The bulk API Certificate of Analysis will indicate the actual percentage. Use this LOD value to calculate the amount of API to weigh for the preparation with this equation:

$$amount\ of\ API = \frac{weight\ in\ formula}{100\% - LOD\ value}$$

*EXAMPLE:*
*Calculate the amount of Lidocaine HCl to be weighed, if a formula calls for 100 gm Lidocaine HCl and the C of A states the water content (or LOD) is 6%.*

$$amount\ of\ Lidocaine\ HCl = \frac{100\ gm}{100\% - 6\%} = \frac{100\ gm}{94\%} = 106.38\ gm$$

## October 2017

## Base vs. Salt/Ester and LOD [1]

USP Chapter <1160> includes a formula that accounts for both the salt or ester versus base, and loss on drying. Knowing each of the values, the amount of drug (or excipient) to be weighed can be calculated with the following equation:

$$W = \frac{ab}{de}$$

W = the amount of salt or ester to be weighed
a = the prescribed amount of drug
b = the molecular weight of the salt or ester
d = the fraction of dry weight when the loss on drying is known *
e = the molecular weight of the base drug or excipient

* Note: The fraction of dry weight is a fraction of the total (assumed to be the number one) minus the loss on drying or moisture content. This is similar to the percentage of dry material, but expressed as a decimal.
[In the previous example, the fraction is equal to 1.0 – 0.06 *(or 6%)* = 0.94.]

*EXAMPLE:*
*Using this equation, calculate the amount of Aminophylline dihydrate USP to weigh, knowing:*

*The prescribed amount of Theophylline (active ingredient in Aminophylline) = 250 mg*
*moisture content = 0.4%*
*MW of Aminophylline dehydrate = 456 gm/mole*
*MW of Theophylline = 360 gm/mole*

$$W = \frac{\left[250\, mg \ \ x \ \ 456\left(\frac{g}{mole}\right)\right]}{\left[(1 - 0.004) \ \ x \ \ 360\left(\frac{gm}{mole}\right)\right]}$$

$$W = \frac{\left[114{,}000 \ \left(\frac{mg \cdot gm}{mole}\right)\right]}{\left[0.996 \ \ x \ \ 360\left(\frac{gm}{mole}\right)\right]}$$

$$= 318\, mg$$

## November 2017

## Iso-osmotic and Isotonic Solutions [4]

Iso-osmotic solutions contain both penetrating and non-penetrating solutes, have the same concentration of particles and exert equal osmotic pressure.

Isotonic solutions contain only non-penetrating solutes and have the same osmotic pressure as the cells they surround *(i.e. there is no loss or gain of water by a cell)*.

Clinically, these are important considerations when compounding solutions in order to prevent cell rupture or pain when the medication is administered.

Dosage forms for which osmotic pressure and tonicity are a concern, include ophthalmics, intravenous, subcutaneous and intrathecal injections, as well as compounds used in neonates.

The Sodium chloride equivalent of a drug represents the amount of Sodium chloride that has the same osmotic pressure as that of 1 gm of the drug.

The Freezing Point Depression concept considers a solution that freezes at -0.52°C to be isotonic with blood and tears. *(Note: the freezing point of blood and tears is -0.52°C.)*

Sodium chloride equivalents and freezing point depression values are frequently used to calculate isotonicty in the preparation of pharmaceuticals. This data is available in many references (e.g. *Remington's Pharmaceutical Sciences*; *Remington's: The Science and Practice of Pharmacy*; and *Ansel-Pharmaceutical Calculations*).

*EXAMPLE:*
*Use Sodium chloride equivalents (E) to calculate the amount of Sodium chloride required to prepare a 60 mL iso-osmotic solution of Atropine sulfate 0.5%.*

*From references:*
*(E) value for Atropine Sulfate = 0.13*
*(E) value for Sodium Chloride = 1*

Step 1: Total amount of substances equivalent to 0.9% (iso-tonic) NaCl = NaCl % x final quantity

$$= \left(\frac{0.9\ gm}{100\ mL}\right) x\ \ 60\ mL$$

$$= 0.54\ gm$$

Step 2: The amount of drug required = drug % x final quantity

$$= \left(\frac{0.5 \text{ gm}}{100 \text{ mL}}\right) \text{ x } 60 \text{ mL}$$

$$= 0.3 \text{ gm}$$

Step 3: Determine number of NaCl equivalents contributed by the drug.

Weight of NaCl equivalents = [amount of drug] x [(E) of drug]

*= 0.3 gm x 0.13 = 0.039 gm NaCl*

Step 4: Determine amount of NaCl to be added to make preparation iso-osmotic

Required amt. NaCl = [total amt. of substances equivalent to 0.9% NaCl] – [wt. of NaCl equivalents]

*= 0.54 gm – 0.039 gm*

*= 0.501 gm (or 0.5 gm of NaCl)*



[1] Freezing Point Depression calculations utilize the same concept – determine the freezing point depression contributed by the drug – then, calculate the amount of NaCl to add (or other excipient) to reach the freezing point depression of the 0.9% NaCl solution. (See example in USP <1160>)

# December 2017

## Capsule Calculations

The capacity of a capsule depends on the density and characteristics of the powders it contains. Therefore, formulating capsules properly is essential to preparing an accurate compound with reproducible results. Without enough filler, capsules may be under filled with a large variation in strength from one capsule to another. Using too much filler results in the empty capsule shell being difficult or impossible to pack or tamp.

Ideally, for immediate-release capsules, 100% active ingredient is the most desirable formula. However, it is rare that the dose required can be encapsulated without addition of a filler. When formulating capsules, there are a number of ways to estimate the needed filler.

Technique #1 – Packing Method [2]

1. Choose the capsule size based on the chart below (in Technique #2, pg. 16). Depending on the equipment available, it is best to choose the smallest capsule size that will accommodate the dose.
2. Pack an empty capsule with the active ingredient and weigh (on balance having been tared with an empty capsule).
3. Calculate the percent of the capsule occupied by the dose:

$$\%\ occupied\ by\ the\ dose\ = \frac{dose\ of\ the\ drug\ (mg)}{weight\ of\ drug\ in\ the\ packed\ capsule\ (mg)}\ x\ 100$$

4. With the filler, repeat Step 2 to determine the total weight of filler that occupies 100% of the capsule.

5. Calculate the percent of the capsule occupied by the filler:

% occupied by the filler = (100%) – (% occupied by the dose)

6. Calculate the weight of filler per medicated capsule using the answers from Steps 4 and 5:

Weight of filler = (total weight of filler)(% occupied by filler)

Technique #2 – Filler Weights [2]

In the second method, estimations are used and may be less useful and accurate than the Packing Method. The use of active ingredients and fillers of similar consistencies is required. The technique requires a simple subtraction of the weight of the active ingredient from the weight of filler that occupies 100% of the capsule. The table below outlines packing weights of various commonly used capsule fillers.

*EXAMPLE*
*How much Lactose is required for a 5 mg Fluoxetine HCl capsule, if we choose a size 4 capsule?*
*From the table below, 190 mg of Lactose will fill a size 4 capsule. Assuming Fluoxetine HCl powder will have similar characteristics of Lactose, the amount of Lactose filler needed can be calculated:*

weight of filler required = weight of filler occupying 100% of capsule – weight of active ingredient

*mg of Lactose as filler = 190 mg (Lactose) – 5 mg (Fluoxetine HCl)*

*= 185 mg*

| Capsule Size | Lactose Anhydrous, USP | Micro-crystalline Cellulose, NF (Avicel PH-105) | Starch, Corn, NF | Hypro-mellose 2910 4,000 cps, USP (Methocel E4M) | Kaolin, USP | Hypro-mellose 2208 100,000 cps, USP (Methocel K100) | Calcium Carbonate |
|---|---|---|---|---|---|---|---|
| | (Powder weight in mg) | | | | | | |
| **4** | 190 | 110 | 180 | 100 | 165 | 100 | 220 |
| **3** | 225 | 130 | 205 | 150 | 250 | 150 | 275 |
| **2** | 300 | 160 | 285 | 188 | 375 | 185 | 350 |
| **1** | 400 | 230 | 375 | 250 | 540 | 250 | 460 |
| **0** | 550 | 320 | 510 | 350 | 600 | 350 | 640 |
| **00** | 775 | 450 | 700 | 475 | 765 | 475 | 925 |
| **000** | 1260 | 725 | 1180 | 620 | 1700 | 620 | 1450 |

*Used with permission from Torpac®, Fairfield, NJ*

This method is an approximation. Adjustments to the formula may be needed depending on how completely the capsule is filled and how much tamping or packing of the powders is required.

Technique #3 – Rule of Sixes [2]

The third method, the Rule of Sixes, is a historically older approach to estimating. When the bulk density of powders is approximately 0.6 gm per cubic centimeter (or milliliter), the size of the capsule can be approximated. According to the rule, the capsule sizes 0, 1, 2, 3, 4 and 5 can hold 6-7, 5, 4, 3, 2, and ½ to 1 grains of the powder, respectively.
Each grain is approximately equivalent to 65 mg.

The diagram below outlines the guide for the Rule of Sixes.

| Capsule size | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Weight of powders** (in grains) | **6-7** | **5** | **4** | **3** | **2** | **½-1** |

## Technique #4 – Powder Density[2]

To determine the density of powders, one can use either a graduated cylinder or a tap Densimeter. The volume of the Densimeter cavity is one milliliter. The Densimeter is tared on a balance. The powders are added to the cavity and then the Densimeter is re-weighed. The resulting weight will be the density in grams per cc, or mL. The compounder may then use either the Rule of Sixes, or consult the capsule vendor specifications to determine the size required (see table below).

| Capsule Size | Typical Fill Weights (mg) Actual Fill Weights may vary and depend on powder characteristics | | | Volume Theoretical |
|---|---|---|---|---|
| | **Powder Density** | | | |
| | **0.45 (Light)** | **0.70 (Typical)** | **1.00 (Heavy)** | **(ml)** |
| **000** | 615 | 960 | 1370 | 1.37 |
| **00** | 430 | 665 | 950 | 0.95 |
| **0** | 305 | 475 | 680 | 0.68 |
| **1** | 225 | 350 | 500 | 0.50 |
| **2** | 165 | 260 | 370 | 0.37 |
| **3** | 135 | 210 | 300 | 0.30 |
| **4** | 95 | 145 | 210 | 0.21 |
| **5** | 60 | 90 | 130 | 0.13 |

*Used with permission from Torpac®, Fairfield, NJ*

*EXAMPLE*
*A physician orders a prescription for Urosodiol 75 mg. Using the Densimeter, it is determined 1 mL weighs 0.750 gm, therefore, the density is equal to 0.75 gm/mL (= 750 mg/mL).*

Using a simple proportion, calculate the volume the dosage will displace.

$$\frac{75\ mg}{x\ mL} = \frac{750\ mg}{1\ mL}$$

*Solving for x,* $x = 0.1\ mL$

Determine the volume of space for the filler:

volume available for filler = theoretical volume (using size 4 capsule) – volume displaced by API

$$= 0.21\ mL - 0.1\ mL = 0.11\ mL$$

*Perform the same technique to calculate the density of the filler (Microcrystalline Cellulose).*
*Using the Densimeter, it is determined 1 mL weighs 0.430 gm (=430 mg).*

*Again, use a simple proportion to calculate the weight of Microcrystalline Cellulose needed to fill the available (size 4) capsule space.*

$$\frac{x\ mg\ MCC}{0.11\ mL\ MCC} = \frac{430\ mg\ MCC}{1\ mL\ MCC}$$

*Solving for x,* $x = 47.3$ *mg Microcrystalline Cellulose*

## January 2018

## Dosage by Weight and Surface Area [1]

The dosage of many medications is based on body weight or surface area. Accurately performing these calculations is critical for individualized medication therapy, and preventing under or overdosing. Body weight dosing is typically calculated based on milligrams of drug per kilogram of body weight over a 24 hour period. The daily dose may then be given in divided doses throughout a 24 hour period.

The equation for body weight dosing is:

$$\left(\frac{\text{mg of drug}}{\text{kg of body weight}}\right) \text{x body weight(kg)} = \text{dose for 24 hour period}$$

Surface area calculations are calculated based on milligrams of drug per body surface area in square meters ($m^2$), also over a 24 hour period. Chemotherapeutic agents are frequently dosed based on body surface area.

The equation for body surface area dosing is:

$$\left(\frac{\text{mg of drug}}{\text{m}^2 \text{ body surface area}}\right) \text{x body surface area}(\text{m}^2) = \text{dose for 24 hour period}$$

*EXAMPLE:*
*A veterinarian orders a prescription for a feline for Fluoxetine HCl suspension to be dosed at 0.5 mg/kg daily for 30 days and to deliver the dose in 1 mL. What dose will be administered if the cat weighs 9.5 pounds? How much Fluoxetine will be needed for the 30 day supply?*

*First, convert the body weight to Kg:*

$$9.5\ lbs\ x\ \left(\frac{1\ kg}{2.2\ lbs}\right) = 4.32\ kg$$

*The daily dose will be:*

$$4.32\ kg\ x\ \left(\frac{0.5\ mg}{kg}\right) = 2.16\ mg$$

*To calculate a 30 day supply:*

*2.16 mg x 30 days = 64.8 mg (or 65 mg) Fluoxetine HCl*

# References


1. USP Chapter <1160>. *USP-38, NF-33 Pharmaceutical Calculations in Pharmacy Practice*. Contact: Jeanne H. Sun, Pharm.D. U.S. Pharmacopeial Convention. Washington, DC. 2015. 1303. Print
2. Allen, Loyd V. Jr. “Pharmaceutical Compounding Calculations.” *The Art, Science, and Technology of Pharmaceutical Compounding, 4th Edition*. Ed. Sandra J. Cannon and Nancy Tarleton Landis. Washington, DC: APhA, 2012. 104. Print.
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