The formula is a picture or graph of the fired glaze. The glaze mixture is made from selected materials each of which has a share in producing the oxides which are expressed in the formula. These materials will now be set forth and explained.

Materials	Symbol	Molecular Weight	Loss in Firing	Oxide Symbol	Formula Weight
White Lead	$Pb(OH)_2 2PbCO_3$	258	$H_2O, 2CO_2$	PbO	222
Whiting	$CaCO_3$	100	CO_2	CaO	56
Feldspar	$K_2O, Al_2O_3, 6SiO_2$	556	none		556
Clay	$Al_2O_3, 2SiO_2, 2H_2O$	258	$2H_2O$	Al_2O_3, $2SiO_2$	222
Flint	SiO_2	60	none		60

White lead is used as a convenient source of lead oxide. It is easily obtained and works well in a glaze batch. The weight used is the amount necessary to carry one unit of lead oxide. It is evident that in the white lead formula Pb occurs three times, therefore the sum of the atomic weights, which is 775, is divided by 3, giving 258 as the nearest whole number. In like manner whiting is chosen as the best available source of calcium oxide or lime. Marble dust is sometimes used and is perfectly good if finely ground.

The construction of the glaze batch may now proceed. The items of the formula are arranged in a horizontal line, each with its value beneath. The first formula given in the previous lecture will be used:

PbO	CaO	K_2O	Al_2O_3	SiO_2
.7	.2	.1	.12	1.36
.7	.2	.1	.10	.60
			.02	.76
			.02	.04
				.72

White lead	.7
Whiting	.2
Feldspar	.1
Clay	.02
Flint	.72

As the white lead and whiting contain each, a single oxide no further discussion is necessary. Feldspar contains three oxides in the proportion of 1 : 1 : 6, so that K_2O .1 carries Al_2O_3 .1 and SiO_2 .6. These figures are subtracted from the line above and there is a deficiency of .02 Al_2O_3 and 76 SiO_2. The needed Alumina is found in clay and a reference to the table will show that .02 clay will contain .02 Al_2O_3 and .04 SiO_2. This completes the alumina value and leaves .72 SiO_2 yet to be found. This is supplied by flint which is pure silica.

So far, only the symbol values of the oxides have been used. The next step is to multiply these by the molecular weights of the materials:

White lead	.7	x 258	= 180
Whiting	.2	x 100	= 20
Feldspar	.1	x 556	= 56
Clay	.02	x 258	= 5
Flint	.72	x 60	= 43

The larger fractions have been brought to whole numbers, the smaller ones drppped. This is sufficiently accurate. The batch of the second formula may be worked in the same way.

PbO	CaO	K_2O	Al_2O_3	SiO_2
.6	.3	.1	.15	1.45
.6	.3	.1	.1	.60
			.05	.85
			.05	.10
				.75

White lead	.6 x 258	= 155
Whiting	.3 x 100	= 30
Feldspar	.1 x 556	= 56
Clay	.05 x 258	= 13
Flint	.75 x 60	= 45
		299

The batches are weighed out and ground in water for use. Each of these is a clear brilliant glaze, the latter will need a slightly higher temperature than the former as may be seen from the fact that the PbO has been lowered from .7 to .6 and the CaO has been correspondingly raised.

A raw glaze is used for the cheaper ware because it is the least expensive in preparation. A glaze which depends upon lead oxide for its fusibility is not, however, suitable for certain types of pottery. It is usually yellowish in color because there is always a certain amount of iron oxide present in the materials and the lead oxide dissolves this; nor is the lead glaze suitable for use over color decoration. The colors will be dissolved and caused to flow. Another objection is that a glaze high in lead oxide will not wear well. The surface is so soft that scratches soon appear and the pieces become unsightly.

All the materials used so far have been practically pure and no adjustment has been necessary. The purity of the feldspar has been assumed so that the calculation could be simplified but there is no pure feldspar on the market For accurate work, therefore, the actual composition of the commercial spar must be ascertained and the formula calculated.

Dealers are generally glad to furnish an analysis of the special brands. One of these, sold under the name of "Madoc" has the composition:

Silica	69.3	divided by	60	=	1.150
Alumina	17.4	"	" 102	=	.171
Iron Oxide	.1				
Potash	8.9	"	" 94	=	.095
Soda	3.6	"	" 62	=	.058

The first rule is, divide each item by the molecular weight of the oxide. The iron oxide may be ignored as a quantity so small will not affect the behavior of the glaze.

Second rule: Assemble the oxides in their respective places:

K_2O	Al_2O_3	SiO_2
.095		
Na_2O .058	.171	1.150
.153		

Third Rule: Add the RO column and divide each item by the sum.

.095	divided by	.153	=	.62
.058	"	" .153	=	.38
.171	"	" .153	=	1.12
1.150	"	" .153	=	7.50

So that the formula is established as:

K_2O	Al_2O_3	SiO_2
.62		
Na_2O .38	1.12	7.50

Then the weight of the material is calculated by multiplying each of these figures by the respective weights of the oxides:

.62	x 94	=	58.2
.38	x 62	=	23.6
1.12	x 102	=	114.0
7.50	x 60	=	450.0
			645.8

The calculation of one of the glaze formulas may now be revised so as to include the use of this feldspar instead of the

pure mineral. Provision is made for the sodium oxide by including it with the potash but as the two oxides form the unit the same value is used as before.

PbO	CaO	$(K_2Na_2)O$	Al_2O_3	SiO_2
.6	.3	.1	.150	1.45
.6	.3	.1	.112	.75
			.028	.700
			.028	.056
				.644

White lead	.6 x	258
Whiting	.3 x	100
Feldspar	.1 x	646
Clay	.028 x	258
Flint	.644 x	60

And the new recipe reads:

White lead	155
Whiting	30
Madoc Feldspar	65
Clay	7
Flint	39
	296

The new feldspar supplies more alumina and silica so that less clay and less flint are needed. The sum of the batch is slightly less than before because a smaller amount of clay means less combined water to be driven off.