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CHALK-MAKING USING ASH WASH AND PLASTER OF PARIS

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ABSTRACT

The study was an experimental venture in chalk-making. It made use of an indigenous welding shop waste material called ash wash, and Plaster of Paris.

Two formulas or treatments were used in the preparation of the chalk, Formula A used 70% Plaster of Paris and 30% ash wash; Formula B had 60% Plaster of Paris and 40% ash wash. Both formulas utilized a 200-mesh sieve so that two treatments of chalk were obtained.

Five casts of sample chalk were prepared on each treatment for quality evaluation based on texture and strength. Thirty-seven faculty members from five academic units in UNP served as evaluators. Each faculty- evaluator was provided 50 pieces of chalk on each formula or ten pieces each of the 5 casts of chalk prepared on the two formulas. Production costs were determined and compared to the present market value of the commercial chalk.

On Formula A, the 1000gram mixture (or 1 kilo) produced 214 pieces of chalk. A 50 kilogram mixture on Formula A (equivalent to one sack) would produce 10,710 pieces or 74.375 boxes of chalk.

About seventeen castings (16.66) were made out of a 1,000-gram mixture on Formula B. One casting produced 15 pieces of chalk and the whole 1,000 gram mixture produced 250 pieces. One sack Plaster of Paris (50 kg) would produce about 12,500 pieces or 86.86 boxes of chalk.

The total production cost of each formula was four-hundred eighty pesos (P 480.00). Unit cost on Formula A was about thirty-five centavos (P 0,045) and cost per box was over six pesos (P 6.45). On Formula B, unit cost was about four centavos (0.38) and cost per box was over five pesos P 5.53).

The commercial chalk was more costly at eighteen pesos and fifty centavos (P 18.50) per box or at thirteen centavos (0,13) per piece of chalk.

INTRODUCTION

At a time when Philippine technology is measly taking off for world class competition, agencies of government are also encouraged to be more innovative and to conduct experiments and improvization activities that can help improve the economy.

Chalk-making through the use of indigenous materials can be one great help. Chalk is an indispensable writing material in the teaching-learning process. It is generally used in all institutions of learning, so that its importance need not be overemphasized. It quite a paradox, however, why there are known attempts in many Philippine schools manufacture white enamel chalk. Agencies and institutions of learning have been depending on the manufacturing companies in Metro Manila for their supply of chalk. The University of Northern Philippines which is the base stitution of this research project procures about 1,400 boxes of white enamel chalk every school year from two big corporations in Metro Manila at the rate of eighteen pesos and fifty centavos (P 18.50) per box, or thirteen centavo (P 0.13) per piece of chalk (Price Index, 1990)

The UNP Center for Research thus perceived this project on chalk-making both as an economic measure and as a step on the road towards technology-building. The project would extend economic benefits not only to UNP but also to other schools in Region I that would purchase chalk from UNP at lower costs.

Ash wash, which was the indigenous material used in the experiment, is so abundant in Region I. It is a waste material in welding shops. Vigan alone has several welding shops, so that a good supply of ash wash would not be a problem. Plaster of Paris, which was the binder used in the experiment, is not also costly.

OBJECTIVES OF THE STUDY

The study attempted to experiment on the use of waste materials in chalk-making. Its ultimate objective was to produce chalk at very minimal costs without sacrificing quality and efficiency.

The study specifically tried to: 1) determine the formula that produces a "very satisfactory" quality of white enamel chalk with regards to texture and strength; 2) determine differences, if any, in the quality of chalk produced from two formulas considering texture and strength; and 3) determine the production costs of the two formulas considering gross cost, unit cost and cost **per box.**

SCOPE AND LIMITATIONS

The investigation had only two phases. Phase I was on experimentation and Phase II was on evaluation.

The study was first concerned with the making of white enamel chalk concentrating on two formulas. (Formula A and Formula B) and using a two-hundred mesh sieve. The two formulas were found to have produced more satisfactory results than three others at a study conducted by Ragasa and Amano in 1989.

Formula A had a mixture of 70% Plaster of Paris and 30% ash wash, while Formula B had 60% Plaster of Paris and 40% ash wash. Both formulas utilized a 200-mesh sieve so that two treatments of chalk were obtained.

The results of the two treatments of chalk were evaluated according to texture and strength. Forty-four (44) faculty members **were** requested to use the two treatments of experimental chalk and to serve as evaluators. Only eighty-four percent (84%) were able to complete their evaluation.

The Experimental Paradigm

The figure below shows the experimental paradigm that was followed in the course of the study.

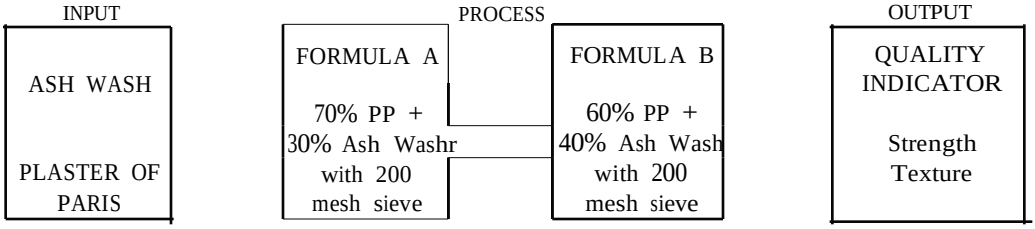

Figure 1. *The Experimental Paradigm*

The quality of the output in tenns of texture and strength was conjectured to be determined by the experimental treatment used. Fonnula A contained 70% Plaster of Paris and 30% ash wash and used a 200-mesh sieve. Formula B contained about 10% less of Plaster of Paris and 10% more of ash wash than Fonnula A; it also used a 200-mesh sieve.

molds in the form of quick setting with water (Webster, 1975: 900).

Sieve. It is **a** device with perforations through which the particles of ash wash and Plaster of Paris are passed to separate coarser particles. A 200-mesh sieve was used for Formula A and Fonnula B.

HYPOTHESIS

The study tried to test the validity of the following hypothesis.

FORMULA A produces an inferior quality of chalk than FORMULA B ON STRENGTH and TEXTURE

DEFINITION OF TERMS

Key tenns used were also defined for a better understanding of the study.

Ash Wash. It is a solid residue from steel and iron work welding. The main chemical component is sodium hydroxide which is usually grayish white in color. It has a strong caustic base which may be used in making soap, crayon, paper and chalk.

Enamel Chalk. It is a writing material composed mainly of Plaster of Paris and ash wash.

Plaster of Paris. It is a white powder slightly hydrated calcium sulphate made by calcining gypsum and used chiefly for casts and

Strength. It refers to the power of piece of white enamel chalk to resist breaking when writing on the hylopate.

Texture. It refers to the visual or tactile surface characteristics and appearance of a **white** enamel chalk which maybe assessed as coarse or smooth.

METHODOLOGY

The study followed two phases and these were: Phase I - Experimentation; and Phase II - Evaluation.

Phase I: Experimentation. This phase volved the conduct of a laboratory experiment on white enamel chalk-making using two treat-

ments/formulas of the indigenous material (ash wash) and Plaster of Paris with only one type of sieve - the 200 mesh sieve. Fonnula A used 70% Plaster of Paris and 30% ash wash, whileFormula B used 60% Plaster of Paris and 40% ash wash. Water, weighing scale and chalk molder were used in the preparation of the chalk.

The steps-followed in the preparation of the white enamel chalk were: (I) drying; (2) pulverizing; (3) screening; (4) batching; (5) pouring and (6) drying. A discussion of these steps is presented below.

Drying. This phase needed the application of heat. The raw materials (ash wash) and Plaster of Paris were dried in order to eliminate the remaining moisture. Sun drying was used instead of kiln drying. This form of drying saved the use of electric current, but it was conducted at a longer duration. Kiln drying would have cost more because of the electric current consumed. Kiln drying is usually preferred to sun drying because of the shorter duration for dyring and because it could totally eliminate the moisture for the raw materials.

Pulverizing. When the materials were thoroughly dried, they were set for the next operation called pulverizing. This simply crushed coarser aggregates into finer ones turning them into powder fonn. Since this experiment dealt mainly with the simple or basic production of chalk, the mortar and pestle technique of pulverizing was used in preparation for the next step known as screening.

Screening. Screening was done to separate the coarser aggregates from the finer ones. The 200-mesh sieve was used.

Batching. After screening the materials into the desired fineness, they were weighed separately according to the proportions required. The step was called batching.

A simple computation of the material for a total batch weight of 1000 grams is shown in Table 1. The volume of water was held constant at 100 ml per. 1000 gram mixture.

Table 1. Proportion of Materials Used In the Preparation Ot Formula A and Formula B Using 1000 Gram Mixture

Materials	Weight	%	Weight	%
White Wash	·300g	30	400g	**40**
Plaster of Paris	7004	70	600g	**60**
HO		1100ml		1100ml

Pouring. After computing the individual weight of the materials, they were altogether poured into a container and mixed with 1100 ml of water. The procedure below was followed.

a. Clean the rubber mold.
b. Assemble the mold and lock it in place using wooden clamp and tightening it with winged knot and bolt.
c. Sprinkle the Plaster of Paris into the container; pour 1100 ml water on the ash wash.
d. Stir moderately to attain a homogenous mixture and consistency.

Drying. The two treatments of molded chalk were again dried to completely eliminate the remaining moisture. This process was done to make the chalk porous.

Phase II: Evaluation of Results. Thirty-seven faculty members were randomly chosen from five academic units of UNP to evaluate the quality of the white enamel chalk based on strength and texture. A rating continuum inversely ranging from 6 to 1 was used in the evaluation with "6" as the highest rating and "I" as the lowest.

Each faculty evaluator was provided 100 pieces of chalk (S0 pieces each of Formula A and B), to evaluate for a duration of two months. The results of the two treatments (formulas) were rated as follows: 6 or "excellent;" 5 or "very satisfactory"; 4 or "satisfactory"; 3 or "moderately satisfactory""; 2 or "needs improvement;" and I or "poor."

The try-out and evaluation were done during the second semester of School Year 1988-1989.

STATISTICAL TREATMENT OF DATA

Descriptive statistics by way of frequency counts, weighted sum and arithmetic mean were used to report the findings on the evaluation conducted on strength and texture of the white enamel chalk, and also, to determine the production costs of chalk.

The qualitative evaluation on texture and strength was based on the table of equivalence presented below:

Mean Rating	Descriptive Rating
5.16 - 6.00	Excellent
4.33 - 5.15	Very Satisfactory
3.50 - 4.32	Satisfactory
2.67 - 3.49	Needs Improvement
1.01 - 1.83	Poor

T-test for order pair observation was used to determine the extent of differences in texture and strength between Formula A and Formula B chalk.

RESULTS

The results of the evaluation done on texture (Table 2) showed that all the five samples on Formula A (70% Plaster of Paris and 30% ash wash) were "satisfactory". The mean ratings ranged from 3.68 to 3.92, which were all equivalent to "satisfactory."

Table 2. Evaluation on Texture of Formula A of the White Enamel Chalk

N=37

Rating	E	VS	S	MS	NI	P		X	DR
Sample	6	5	4	3	2				
1	0	14	11	6	5	1	143	3.86	S
2	1	11	13	8	4	0	145	3.92	S
3	0	11	11	9	5	1	137	3.70	S
4	0	9	13	9	6	0	136	3.68	S
5	2	9	13	7	6	0	142	3.84	S
Sum	3	54	61	39	26	2			
Weighted Sum	18	270	244	117	52	2	703	3.80	S

The "satisfactory" texture of Formula A indicated that the visual and tactile surface characteristics of the chalk were acceptable to the faculty-users, The texture of the chalk may still be improved to a "very satisfactory" level, or to an "excellent" level with the use of a finer molder.

Formula B exhibited better results on texture. The mean ratings obtained ranged from 4.19 to 4.35. The aggregate evaluation of the five samples on Formula B reported a mean rating of 4.26, which was also equivalent to "satisfactory" but was evidently higher than that given to Formula A, 3.80.

Table 4 shows a comparative evaluation on the texture of chalk produced from Formula A and Formula B. Only Sample 2 of Formula B was rated "very satisfactory." Formula B obtained a mean rating difference (MR) of +0.46 from the mean r of Formula A. The descriptive ratings (DR), however, showed no differences between the two treatments. Both formulas produced a quality of chalk that was just "satisfactory" to the evaluators with regards to smoothness.

The texture of the chalk produced from the two formulas may still be improved with the use of a finer sieve and a non-rubberized mold.

***Table** 3 Evaluation on Texture of Formula B of White Enamel Chalk*

Rating	E	VS	S	MS	NI	p	MR	DR
Sample	6	5	4	3	2			
1	6	13	9	5	4	160	4.32	S
2	6	14	7	7	3	161	4.35	VS
3	5	12	11	6	3	158	4.27	S
4	6	11	9	6	5	155	4.19	S
5	7	11	8	4	7	155	4.19	S
Sum	30	61	44	28	22			
Weighted Sum	180	305	176	84	44	789	4.26	S

Table 4. A Comparative Evaluation on Texture of Formula A and Formula B of the White Enamel Chalk

Ratings	FORMULA A		FORMULA B	
Samples	MR	DR	MR	DR
1	3.86	S	4.32	S
2	3.92	S	4.35	VS
3	3.70	S	4.27	S
4	3.68	S	4.19	S
5	3.84	S	4,19	S
Weighted Average	3.80	S	4.26	S

MR = Mean Rating DR = Descriptive Rating

Qn Strength. Results of the evaluation made on strength of the chalk produced from the two formulas are reported in Table 5.

Samples 1, 2 and 3 of Formula A (which means 3 out of 5 samples) were rated "very satisfactory." The aggregate mean rating was 4.36, which was equivalent to "very satisfactory." Such results indicatedthat the blending **of** 70% Plaster of Paris and 30% ash wash (Formula A) can produce chalk that does not **easily** break when used for writing.

On Formula B, all the five samples obtained mean ratings equivalent to "very satisfactory." Formula B may be said to produce a better quality or a more durable type of chalk than Formula A.

***Table 5. A Comparative Evaluation** on Strength of Formula **A and** Formula B **of the White** Enamel Chalk*

Ratings	FORMULA **A**		FORMULA B	
Samples	MR	DR	MR	DR
1	4.35	VS	4.49	VS
2	4.41	VS	4.49	VS
3	4.41	VS	**4.54**	VS
4	4.30	S	4.54	VS
5	4.32	S	4.38	VS
Weighted Average	4.36	VS	4.49	VS

Significance of Differences in Quality Between Formula A and Formula B

The above discussions already indicated slight arithmetical differences on texture and strength between Formula A and Formula B. Such data, however, were not taken as statistically sufficient to prove the significance or insignificance of differences in quality between the two formulas with regards to texture and strength.

***Table 6. Significance of Difteronces** in **Texture and Strength Between Formula** and Formula B ot White Enamel Chalk*

Quality of Chalk	d	Sd	Computed t-value	CV	Remark
as to texture	.464	.083	12.51	2.78..	HS
as to strength	.13	.07	4.15	2.78	S

d = mean difference between Formula A and B
.. = also significant at .01 level
Sd = standard deviation of mean difference
HS = highly significant
CV = critical value
S = significant

Results of the I-test for order pair observation indicated that there was a "highly significant" difference in the texture of chalk produced from Formula A and Formula The computed t-value exceeded greatly the critical value *at* .05 significance level. The difference was also "highly significant" at .0 level.

The white enamel chalk that contained 60% Plaster of Paris and 40% ash wash (Formula B) was evaluated as better in strength than the mixture that had 70% Plaster of Paris and 30% ash wash (Formula A). The difference was found significant at .05 level.

All these findings led the researchers believe that Formula A produces an inferior quality of chalk than Formula B with regards to texture and strength."

Production Cost of the White Enamel **Chalk**

A. Production Cost of Formula **A** (70% Plaster of Paris and 30% Ash Wash) Using **a** 1,000-Gram Mixture

A total of 14.28 castings was made of **a** 1,000-gram mixture of Plaster of Paris and ash wash. One casting produced 15 pieces of chalk. The 1000-gram mixture which was

equivalent to one kilo produced 214.2 pieces of chalk.

On the basis of these results, 50 kilograms of Plaster of Paris (equivalent to one sack) would be able to produce 10,710 pieces of chalk. If a standard box of chalk contains 144 pieces, then one sack would produce 74.375 boxes of chalk. At eighteen pesos and fifty centavos (P 18.50) per box of commercial chalk, (Price Index, 1990), a sack of the mixture would have a commercial value amounting to one thousand three hundred seventy-five and ninety-four centavos (P 1,375.94).

Itemized costs in producing Formula A included: a) 50 kg sack of Plaster of Paris, (P 300.00); b) wage of 2 student laborers for two days at P 20.00 each (P 80.00); and c) honorarium for the researcher at fifty pesos a day,(P 100.00).

The total production cost was four-hundred eighty pesos (P 480.00); unit cost was about four centavos (P 0.038); and cost per box of chalk was over five pesos (P 5.53). This production cost was about 286% cheaper than the commercial chalk.

If outside laborers were hired at fifty pesos a day (P 50.00) for two days, the total production cost of Formula A would be six-hundred pesos (P 600.00); unit cost would be about six centavos (P 0.056) and cost per box would be over eight pesos (P 8.07). This costing scheme would make the experimental chalk 229% cheaper than the commercial brand.

Table 7. Production Costs of Formula A and Formula B In Chalk Making

Using a 50 kg.	FORMULA A		FORMULA B		DIFFERENCE	
Sack of Mixture	SL(2)	OL(2)	SL(2)	OL(2)	SL	OL
Gross Cost	P 480		480	p 600		
Unit Cost	.045	.056	.038	.048	.007	.008
Cost/Box	6.45	8.07	5.53	6.91	.92	1.16

SL = Student Labor @ P 20.00/day OL = Outside Labor @ P 50.00/day

B. Production Cost of Formula B (60% Plaster of Paris and 40% Ash Wash) Using 1000 gram Mixture

Out of a 1,000-gram mixture on Formula B which was equivalent to one kilo, 16.66 castings or 2.83 more than Formula A was made. One casting produced 15 pieces of chalk. The 1,000 gram mixture on Formula B produced 250 pieces of chalk, or 36 pieces more than that of Formula A.

With the results on Formula B as basis, one sack of Plaster of Paris (50 kg) would produce about 12,500 pieces of chalk or 36.86 boxes.

A comparative presentation on the production costs of Formula A and Formula B is presented in Table 7. Under the two formulas, the unit cost would be cheaper when student labor is used. The difference in cost when outside labor is used is not significant on unit cost (P 0.001), but quite significant on cost per box (P 0.24).

C. Comparison of the Production Cost 9f Formula A and Formula B

Table 7 presents the comparative proauction cost of the two formulas: A = 70% Plaster of Paris + 30% ash wash; and B = 60% Plaster of Paris + 40% ash wash.

One sack of Plaster of Paris cost three-hundred pesos (₱ 300.00). Student labor for two which lasted for two days cost eighty pesos (₱ 80.00). The honorarium for the principal researcher was fifty pesos (₱ 50.00) per day, or a total of one hundred pesos (₱ 100.00). Ash wash was free of charge and so were the molders since these were old ones. A new molder would, however, cost about two-hundred pesos.

Considering all expenditures incurred, the total production cost of the experimental chalk was four-hundred eighty pesos only (₱ 480.00) with student labor and six-hundred pesos (₱ 600.00) with outside labor.

If one box of the commercial chalk cost eighteen pesos and fifty centavos (₱ 18.50), the experimental chalk was 268% cheaper than the commercial chalk.

If two outside laborers were hired at fifty pesos (₱ 50.00) a day, total wages would amount to two hundred pesos (₱ 200.00). The total production cost would be six hundred pesos (₱ 600.00). The cost per piece of chalk would be from five to six centavos (₱ 0.056); per box of chalk, eight pesos or more (₱ 8.07). Using this scheme, the experimental chalk would still be about 229% cheaper than the commercial chalk.

CONCLUSIONS

I. Ash wash, which is a waste material in welding shops, makes a good indigenous combining material to Plaster of Paris under controlled treatments.

2. A mixture *ot* 60% plaster of Paris and 40% ash wash produces a very satisfactory quality of white enamel chalk in texture and strength. A lesser proportion of the ash wash in the mixture would produce a significantly inferior quality of chalk.

3. The production cost of the experimented chalk is 286% cheaper than the commercial chalk.

4. With a total batch weight of 1000 grams (300 g ash wash and 700 g Plaster Paris) total production cost would be less than five hundred pesos (₱ 480.00) ; unit cost would be about four centavos (₱ 0.38) ; and cost per box would be about five pesos .and fifty-three centavos (₱ 5.53).

5. With a lesser proportion of the indigenous material (30%). unit cost would be more than six pesos (₱ 6.45).

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