



Please return to  
Container Section  
The Institute of Paper  
Chemistry  
Appleton, Wisconsin 54911

## **MASKING OF DIPHENYL ODOR IN ORANGES**

Project 1108-7A  
Progress Report One  
to

**FOURDRINIER KRAFT BOARD INSTITUTE, INC.**

April 21, 1953

THE INSTITUTE OF PAPER CHEMISTRY

APPLETON, WISCONSIN

Project 1103-7A

MASKING OF DIPHENYL ODOR IN ORANGES

Progress Report One

to

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

April 21, 1953

THE INSTITUTE OF PAPER CHEMISTRY

APPLETON, WISCONSIN

MASKING OF DIPHENYL ODOR IN ORANGES

The chemical compound diphenyl (or phenylbenzene) is an aromatic hydrocarbon which has been used for a number of years as a preservative for oranges. This material is particularly effective in controlling stem rot and blue mold which are the two most frequently encountered types of spoilage. Undoubtedly diphenyl owes its fungistatic properties to the unique arrangement of the carbon and hydrogen atoms in the diphenyl molecule. Although this arrangement imparts the highly desirable fungistatic properties, it also imparts an undesirable, and in some cases offensive, odor which is a definite disadvantage particularly as the odor is most unlike the odor of oranges.

Numerous attempts have been made to eliminate or mask the offensive odor of diphenyl by the use of various masking agents in the hope of obtaining a blend which would be compatible with the natural orange odor. In order for any masking agent to be effective, it must meet certain requirements, as follows: (1) the resulting blended odor must be compatible with that of oranges so as to impart no "off color" odor to the oranges; (2) it should have approximately the same vapor pressure as diphenyl so that the masking effect or bouquet will endure during the life of the diphenyl; (3) it should impart nontoxic and nondeleterious effects on the fruit; (4) it may intensify but it should not decrease the fungistatic effect of the diphenyl.

The current study is a continuation of an earlier study initiated at The Institute of Paper Chemistry at the request of the

Fourdrinier Kraft Board Institute. A formulation was desired which would either mask the diphenyl odor or blend with it in such a manner that the resultant odor would be compatible with the natural odor of oranges. The initial study or phase terminated in the development of a bouquet consisting of the following components which are identified by code letter:

1.6 grams A  
3.2 grams B  
12.8 cc. C  
454 grams (1 pound) diphenyl

The above formulation was a marked improvement on diphenyl or existing blended formulations and has been used successfully in Phenodor-X since its development.

Although the above formulation was a marked improvement, it left much to be desired, particularly as the bouquet did not blend with the diphenyl to produce an "orange odor," and secondly, the offensive odor of diphenyl could still be detected.

The current study was initiated to endeavor to improve the present masking formulation. It is readily apparent that there is a psychological effect or sales resistance to fruit containing an unnatural or "off-color odor," and a better blend would be desirable. The results obtained to date in pursuit of the above objective are given below.

#### GENERAL PROCEDURE

This particular study was carried out in two phases. The first or preliminary phase was used primarily as a coarse screening of the various additives proposed as masking agents. In this phase the masking agents were mixed with diphenyl in a benzene solution (100% diphenyl and 0.5% additive) and the resulting solution applied to a piece of heavy paper (clean blotter stock). After allowing the solvent to evaporate (approximately 30 minutes) the treated piece of paper was placed in a sealed glass jar either alone or in the presence of an orange. The "blended odor" was evaluated by sniffing the atmosphere of the jar. In this evaluation, a panel of two people was used. The materials initially examined for their masking potentials are given in Tables I and II together with their odor rating which was on a "yes" or "no" basis. It may be seen that the majority of the materials, either alone or in mixtures, did not appear suitable. However, on the basis of the results shown in Tables I and II, a third series of mixtures were formulated. These are given in Table III. Also, the masking potentials of these bouquets were examined more critically.

In the second phase of this study, two series of formulations were tried. The first series consisted of the formulations shown in Table IV and were evaluated in the same manner as described for the first phase. The various formulations given in Table IV were evaluated for their masking potentials and the most promising ones together with minor variations of those selected were used for further study. The formulations used in this latter work are given in Table V.

TABLE I

FORMULATIONS OF DIPHENYL AND MASKING AGENT  
(10% Diphenyl in Benzene)

Formula Number	Masking Agent	Odor Rating
1	D	No
2	E	No
3	F	Yes
4	G	No
5	H	Yes
6	I	Yes
7	J	Yes
8	K	No

TABLE II

DIPHENYL AND MASKING AGENT FORMULATION  
(10% Diphenyl in Benzene)

Formula Number	Masking Agent Type	Per cent*	Odor Rating
1a	A	0.67	No
	B	0.33	
	H	1.0	
1b	A	0.67	Yes
	B	0.33	
	I	1.0	
1c	A	0.67	Yes
	B	0.33	
	J	1.0	
1d	A	0.67	No
	B	0.33	
	F	1.0	
	C	5.0	
1e	A	0.67	Yes
	B	0.33	
	J	1.0	
	C	5.0	

\*Per cent based on diphenyl.

TABLE III

MASKING FORMULATIONS USED  
(10% Diphenyl in Benzene)

Formula Number	Masking Agent Composition				Odor Rating
	N %	L %	K %	I %	
11	0.5	5	0.0	0.0	Yes
12	0.5	5	1.0	0.0	No
13	0.5	5	0.0	1.0	Yes
14	0.5	5	1.0	1.0	No
15	0.5	5	0.5	0.5	No
16	0.5	5	1.0	0.5	No
17	0.5	5	0	0.5	Yes

TABLE IV

MASKING AGENT FORMULATION  
(10% Diphenyl in Benzene)

Formula Number	Amount Material Used, %				
	C	M	I	J	N
18	1	1	0.5	0.1	0.1
19	2	2	1	0.2	0.2
20	1	0.5	0.5	0.1	0.1
21	1	0.2	0.5	0.1	0.1
22	1	0.1	0.5	0.1	0.1
23	1	0.5	0.5	0.1	0.06
24	2	0.5	0.5	0.1	0.06
25	1	1	0.5	0.1	0.06
26	2	1	0.5	0.1	0.06
27	3	0.5	0.5	0.1	0.06
28	2	1.0	0.5	0.1	0.03
29	3	0.5	0.5	0.1	0.03
30	4	2	1	0.2	0.12
31	6	1	1	0.2	0.12
32	4	2	1	0.2	0.06
33	6	1	1	0.2	0.06
34	4	1	1	0.2	0.12
35	4	0.5	1	0.2	0.12
36	4	0.2	1	0.2	0.12

TABLE V  
EVALUATION OF MASKING AGENTS IN PRESENCE OF ORANGES

Formula Number	C	Masking Agents, %				Panel Rating* Average
		M	I	J	N	
28	2	1	0.5	0.1	0.03	0
29	3	0.5	0.5	0.1	0.03	-1
30	4	2	1	0.2	0.12	0
31	6	1	1	0.2	0.12	2
35	4	0.5	1	0.2	0.12	1
36	4	0.2	1	0.2	0.12	0
37	Phenodor-X					0
38	Diphenyl only					-1
38a	No diphenyl, only oranges					3
39	6	2	1	0.2	0.12	0
40	8	2	1	0.2	0.12	0
41	4	2	1.5	0.2	0.12	1
42	8	1	1	0.2	0.12	0
43	12	2	1	0.2	0.12	0
44	6	1	1	0.2	0.00	1
45	10	2	1.25	0.2	0.00	0**

\*These odor ratings are as follows: 3, very good;  
2, good;  
1, passable;  
0, objectionable;  
-1, very bad

\*\*Rated as objectionable because of too much orange.

Evaluation of the masking potentials of the formulations shown in Table V was carried out as follows: Regular slotted corrugated containers, size 6 x 6 x 6 inches were coated on the inside of the four side panels and the inside bottom flaps with a benzene solution containing 2.7 grams of diphenyl and the selected formulations given in Table V. Each box so treated was permitted to "dry" for 30 minutes before being packed with nine oranges, and the flaps sealed. After standing over night at room atmosphere, the resultant odor--i.e., oranges plus diphenyl plus masking agent--was evaluated by a panel of observers. The average rating of the panel is given in Table V.



Of the various mixtures given in Table V, 30, 31, 44, and 45 seem to be the best for providing an odor compatible with the odor of oranges. Of these four mixtures, 31 seems to be preferable to the other three.

Possible costs of the additives in the four mixtures are given in Table VI, the prices being quoted as of March, 1953.

TABLE VI

Additive	Price per Pound, dollars	Cost per Pound of Diphenyl			
		No. 30	No. 31	No. 44	No. 45
C	1.10	0.044	0.066	0.066	0.110
M	4.50	0.090	0.045	0.045	0.090
I	7.75	0.078	0.078	0.078	0.097
J	7.75	0.016	0.016	0.016	0.016
N	3.15	0.005	0.005	0.005	0.005
Total		0.233	0.190	0.205	0.313

At the present time formulation 31 is being tried on a commercial basis; however, The Institute of Paper Chemistry has not been advised of the reaction of the consumer to oranges so packed.

IPST HASELTON LIBRARY



5 0602 01062626 7