

## THE STUDY OF KEY-JO CLAY AS A TABLET DISINTEGRATOR

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Key-Jo Clay - a naturally occurring scentless white powder easily surface mined in many inland places of Korea - was found to compare favorably with corn starch, calcium carboxy methyl cellulose, kaolin, calcium silicate and pectin as a tablet disintegrator. Furthermore, even when added until the clay was 25 percent of the tablet weight, the hardness of the tablet was more than 5.0 kg and disintegration time did not vary from other lower concentrated disintegrators such as corn starch, etc.

In Korea, Key-Jo Clay proved to be of value not only as a deodorizer and decolorator in most chemical engineering fields, but also when used medically as gastric absorbents, antacids and antidiarrheics.<sup>1</sup>

Studies dealing with toxicity of the clay have been carried out by Chun.<sup>2</sup> No toxicity was

demonstrated in rabbits, mice and rats after oral administration in single high-level doses. Also, it did not give rise to irritation when tested on the skin and mucous membranes of rabbits, guinea pigs and humans. An analysis and purification of the clay has been carried out by Chang.<sup>3</sup> He showed that the clay was composed of aluminum calcium silicate and frequently contaminated with ferric oxide, magnesium carbonate, calcium carbonate and aluminum magnesium silicate.

## MATERIALS AND METHODS

### Materials and Instruments

Key-Jo Clay

Starch, U.S.P.

Calcium p-aminosalicylic acid, U.S.P.

Pectin, U.S.P.

Calcium carboxymethylcellulose

Kaolin, U.S.P.

Calcium silicate

Magnesium stearate, U.S.P.

AMF powder and dough mixer

Oscillating granulator, Stokes

Electric granule dryer, Tray type

Stokes rotary tablet press

Tablet hardness tester, Heberlein

Vanderkemp tablet disintegration tester

### Tablet Preparation

As Becker employed in his procedure, Key-Jo Clay, corn starch, calcium carboxy methyl cellulose, kaolin, calcium silicate and pectin were dried at 50 degree C for twenty-four hours in the electric drying

cabinet before granulation.<sup>4</sup> Batches of tablets with each tablet containing 0.5, 1, 2, 4, 8, 15 and 25 percent disintegrating agents were prepared by using 50 kg of calcium p-Aminosalicylic acid as an active ingredient with 15 percent corn starch paste as a binder. By using wet granulation technique, applying dough mixer and oscillating granulator, the prepared wet granules were dried in the electric granule dryer at 60 degree C and sieved separately to 16-24 mesh, 24-30 mesh, 30-40 mesh and 50-60 mesh batches. Ten kg. of each different mesh batch granules were mixed with 0.5 percent equivalent quantity of magnesium stearate as a lubricant and tablets were prepared in Stokes Rotary Tablet Press machine using concave punch, 1.5 ton pressure, 3500 tablets per hour speed, 9 mm filling, 550 mg tablet weight and 6.5 - 8.5 kg tablet hardness. At the same time, calcium p-Aminosalicylic acid tablets were made without the disintegrator for blank standard. A total of 172 batches of tablets were prepared and tested for disintegration time and hardness according to the United States Pharmacopeia, XIX. These 172 batches were as follows: 168 batches which were a combination of different tablet disintegrators, their different concentration in the tablets and different granule

sizes used in preparation; 4 batches of blank standard tablets using different granule sizes.

### Sampling and Hardness Test

During the process of tablet preparation, samples of 30 tablets at six different times for a total of 180 tablets per batch were collected and the hardness was tested with a Heberlein Tester. Tables 1, 2, 3, and 4 show the value. U.S.P. XIX tablet disintegration test method was used for the tablet disintegration test. Tables 1, 2, 3, and 4 show the value.

### RESULTS

In general, disintegration time of tablets was directly related to the size of the tablet and inversely related to the concentration of the disintegrator in the tablet. Figures 1, 2, 3, 4, and 6 show the relation.

Corn starch, as the disintegrator, when added as 8 percent of the tablet weight starts capping and when more than 15 percent becomes too soft to be tested for hardness.

Four percent or more of pectin as the tablet disintegrator exceptionally prolonged the disintegration time as shown in Figure 5.

TABLE I  
The Disintegration Time and Hardness of Tablets Containing Various  
Concentrations of Disintegrating Agents (Prepared from 16-20 Mesh  
Granulations)

Disintegrating Agent	Tests	% CONCENTRATION OF DISINTEGRATING AGENT							
		0	0.5	1	2	4	8	15	25
Corn Starch	Disintegration time in Sec. Hardness in Kg.	1860 8.50	1445 8.00	1370 7.50	762 8.20	145 7.50	54 6.50	50 4.25	26 2.50
Ca-C.M.C.	Disintegration time in Sec. Hardness in Kg.	1860 8.50	1830 8.75	1260 8.20	1080 8.00	840 8.50	360 7.50	60 6.50	30 4.25
Kaolin	Disintegration time in Sec. Hardness in Kg.	1860 8.50	1820 8.50	1020 7.00	815 7.75	600 5.75	410 5.50	180 6.50	120 3.50
Ca-Silicate	Disintegration time in Sec. Hardness in Kg.	1860 8.50	1810 8.75	970 8.50	780 7.50	540 7.75	330 7.50	120 7.75	62 6.00
Pectin	Disintegration time in Sec. Hardness in Kg.	1860 8.50	1365 7.75	1120 8.75	810 8.00	1115 7.75	1350 6.25	2600 7.00	3690 4.00
Key-Jo Clay	Disintegration time in Sec. Hardness in Kg.	1860 8.50	1410 8.00	1020 8.50	840 8.25	380 7.75	225 7.25	120 6.00	60 4.50

TABLE II  
The Disintegration Time and Hardness of Tablets Containing Various  
Concentrations of Disintegrating Agents (Prepared from 24-30 Mesh  
Granulations)

Disintegrating Agent	Tests	% CONCENTRATION OF DISINTEGRATING AGENT							
		0	0.5	1	2	4	8	15	25
Corn Starch	Disintegration time in Sec. Hardness in Kg.	1776 8.25	1380 8.50	1175 8.00	610 8.50	196 8.30	98 6.70	53 3.75	25 0.25
Ca-C.M.C.	Disintegration time in Sec. Hardness in Kg.	1776 8.25	1747 8.90	1202 8.75	1030 8.50	802 8.00	343 8.75	57 5.75	28 4.50
Kaolin	Disintegration time in Sec. Hardness in Kg.	1776 8.25	1734 8.25	972 8.00	778 7.50	572 6.00	391 7.25	172 5.00	114 4.50
Ca-Silicate	Disintegration time in Sec. Hardness in Kg.	1776 8.25	1725 8.50	925 8.75	744 7.75	516 7.50	314 7.75	114 7.25	59 5.25
Pectin	Disintegration time in Sec. Hardness in Kg.	1776 8.25	1308 8.75	1068 8.25	772 8.00	1061 7.50	1288 8.75	2480 5.75	3521 3.00
Key-Jo Clay	Disintegration time in Sec. Hardness in Kg.	1776 8.25	1202 7.75	970 8.50	626 7.75	280 8.00	188 7.00	88 6.25	44 5.00

TABLE III  
The Disintegration Time and Hardness of Tablets Containing Various Concentrations of Disintegrating Agents (Prepared from 30-40 Mesh Granulations)

Disintegrating Agent	Tests	% CONCENTRATION OF DISINTEGRATING AGENT							
		0	0.5	1	2	4	8	15	25
Corn Starch	Disintegration time in Sec. Hardness in Kg.	1580 8.50	1229 9.00	1045 8.25	544 8.75	174 7.75	87 6.75	47 --	22 --
Ca-C.M.C.	Disintegration time in Sec. Hardness in Kg.	1580 8.50	1555 8.25	1120 8.25	915 8.75	715 8.25	805 8.00	51 6.00	25 4.75
Kaolin	Disintegration time in Sec. Hardness in Kg.	1580 8.50	1545 7.75	864 8.50	693 7.75	508 6.25	348 7.50	153 5.25	101 4.75
Ca-Silicate	Disintegration time in Sec. Hardness in Kg.	1580 8.50	1535 8.00	823 8.25	662 8.00	458 7.75	279 8.00	101 7.50	52 5.50
Pectin	Disintegration time in Sec. Hardness in Kg.	1580 8.50	1162 8.25	950 7.75	687 8.25	945 7.75	1145 8.50	2217 6.00	3139 3.25
Key-Jo Clay	Disintegration time in Sec. Hardness in Kg.	1580 8.50	980 8.50	863 8.75	556 8.00	248 8.25	167 8.75	78 6.50	39 5.25

TABLE IV  
The Disintegration Time and Hardness of Tablets Containing Various  
Concentrations of Disintegrating Agents (Prepared from 50--60 Mesh  
Granulations)

Disintegrating Agent	Tests	% CONCENTRATION OF DISINTEGRATING AGENT								
		0	0.5	1	2	4	8	15	25	
Corn Starch	Disintegration time in Sec. Hardness in Kg.	1372 8.25	1064 8.72	907 8.00	473 8.75	151 8.50	76 6.00	41 ---	19 ---	
Ca-C.M.C.	Disintegration time in Sec. Hardness in Kg.	1372 8.25	1350 8.00	972 8.00	795 8.75	621 8.25	265 8.00	44 6.50	22 5.50	
Kaolin	Disintegration time in Sec. Hardness in Kg.	1372 8.25	1341 7.70	750 8.00	602 8.00	442 7.50	362 7.50	133 5.75	88 5.50	
Ca-Silicate	Disintegration time in Sec. Hardness in Kg.	1372 8.25	1331 7.75	715 8.00	575 8.00	398 7.50	242 8.00	88 8.00	45 5.75	
Pectin	Disintegration time in Sec. Hardness in Kg.	1372 8.25	1010 8.00	825 7.50	596 8.25	821 7.75	994 8.50	1924 6.50	2723 3.75	
Key-Jo Clay	Disintegration time in Sec. Hardness in Kg.	1372 8.25	852 8.75	750 8.75	483 8.00	216 8.25	145 8.75	68 7.00	34 6.00	



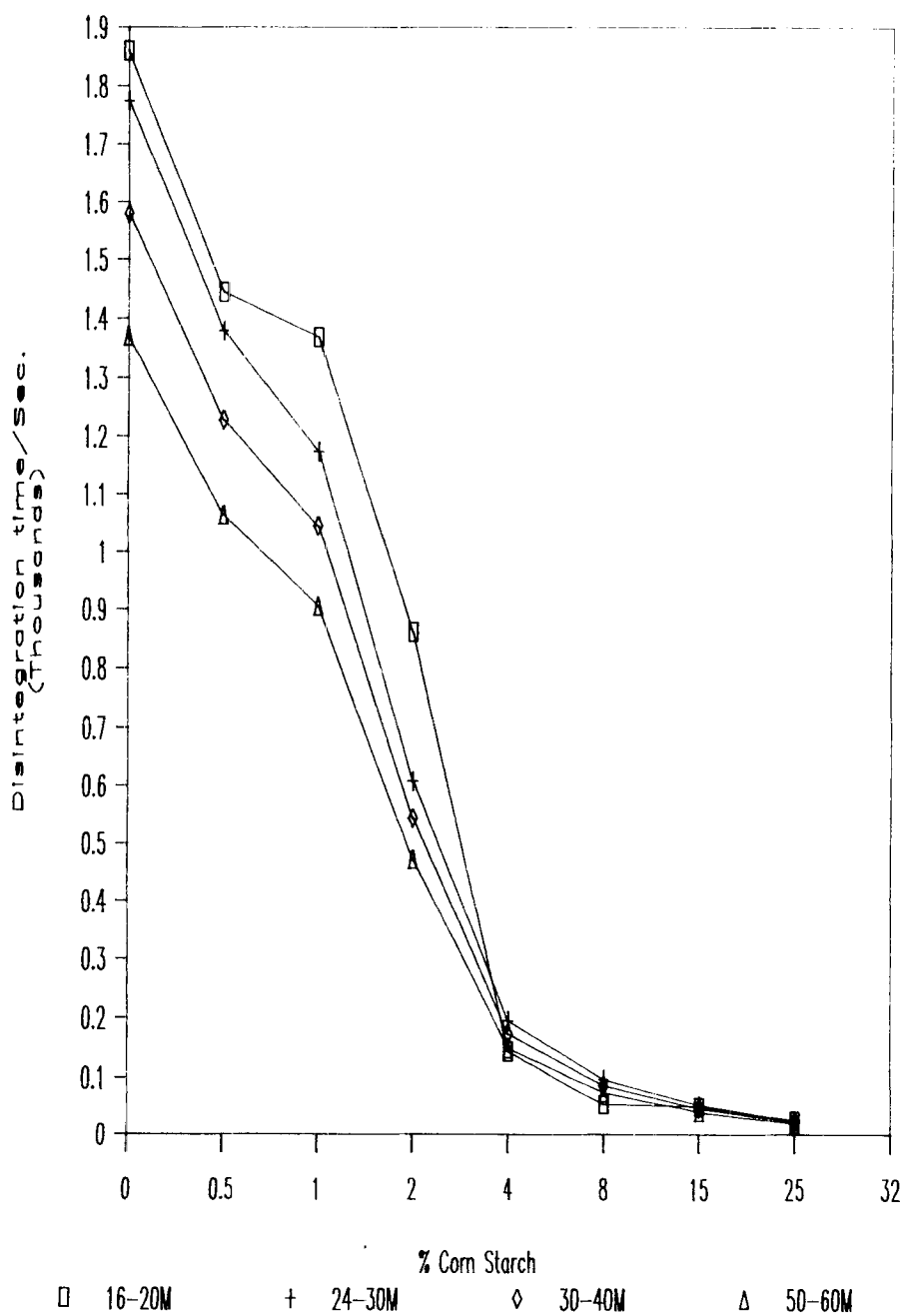


FIG.1: Disintegr. of Corn Starch

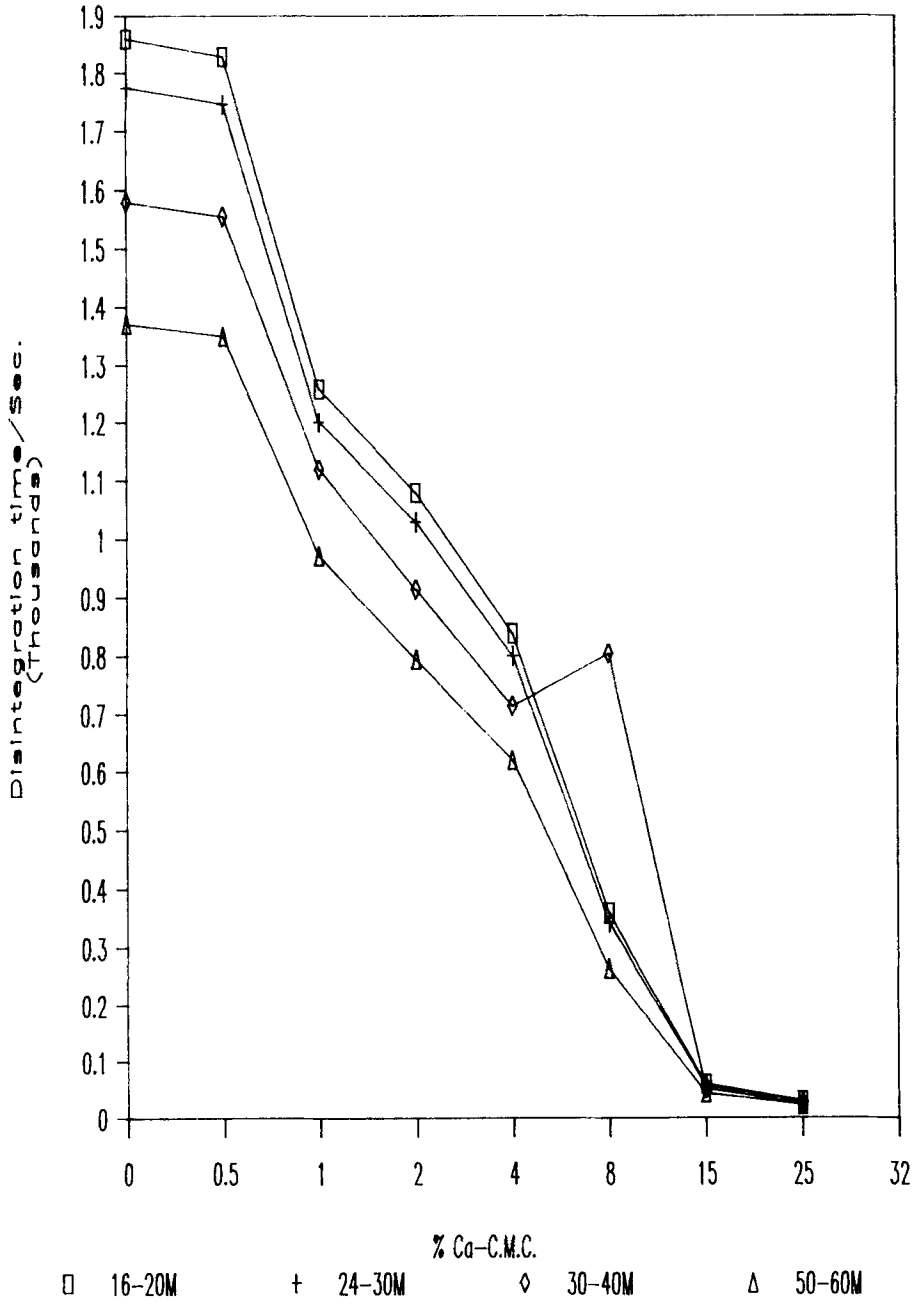


FIG.II: Disintegr. of Ca-C.M.C.

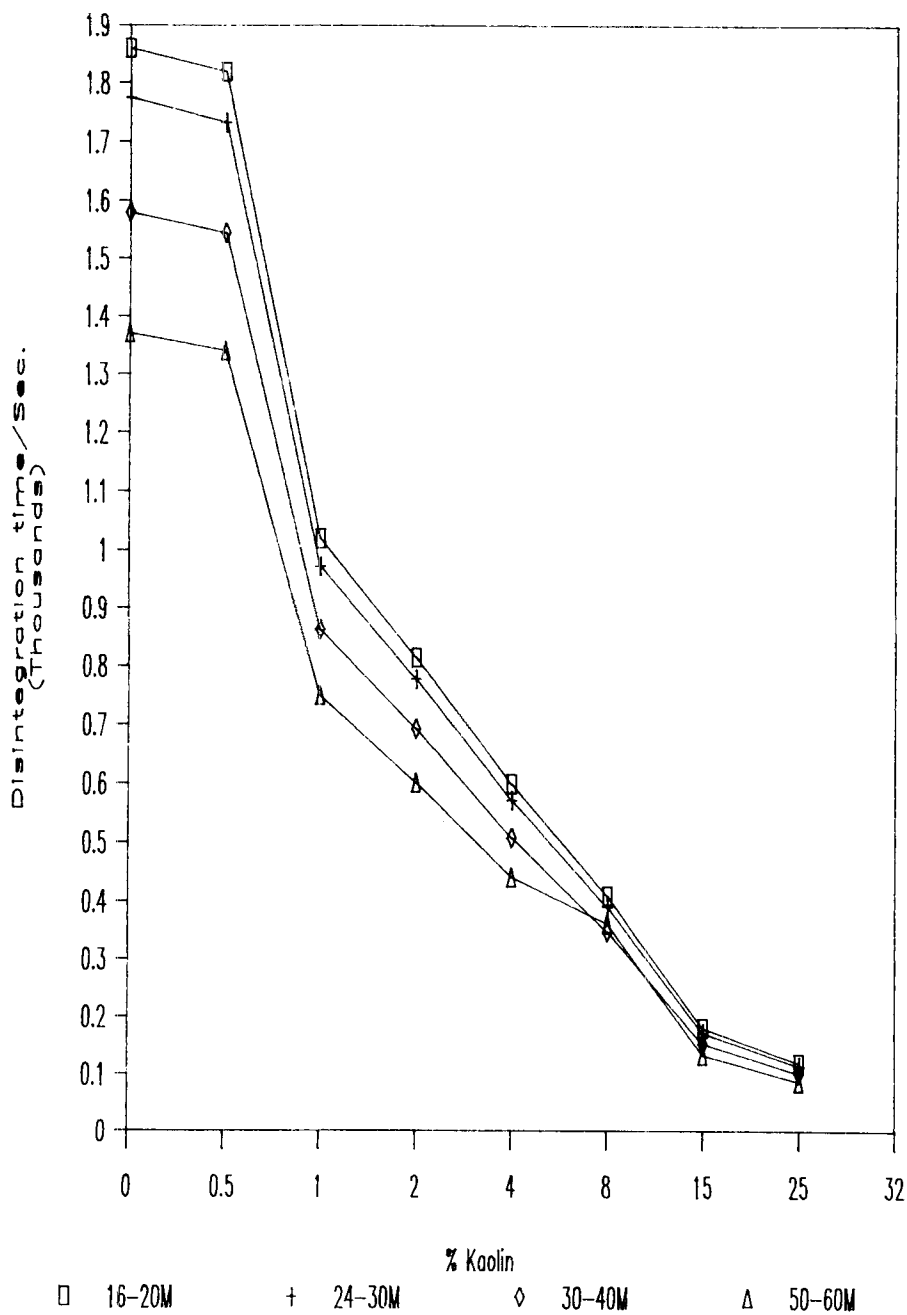


FIG.III: Disintegr. of Kaolin

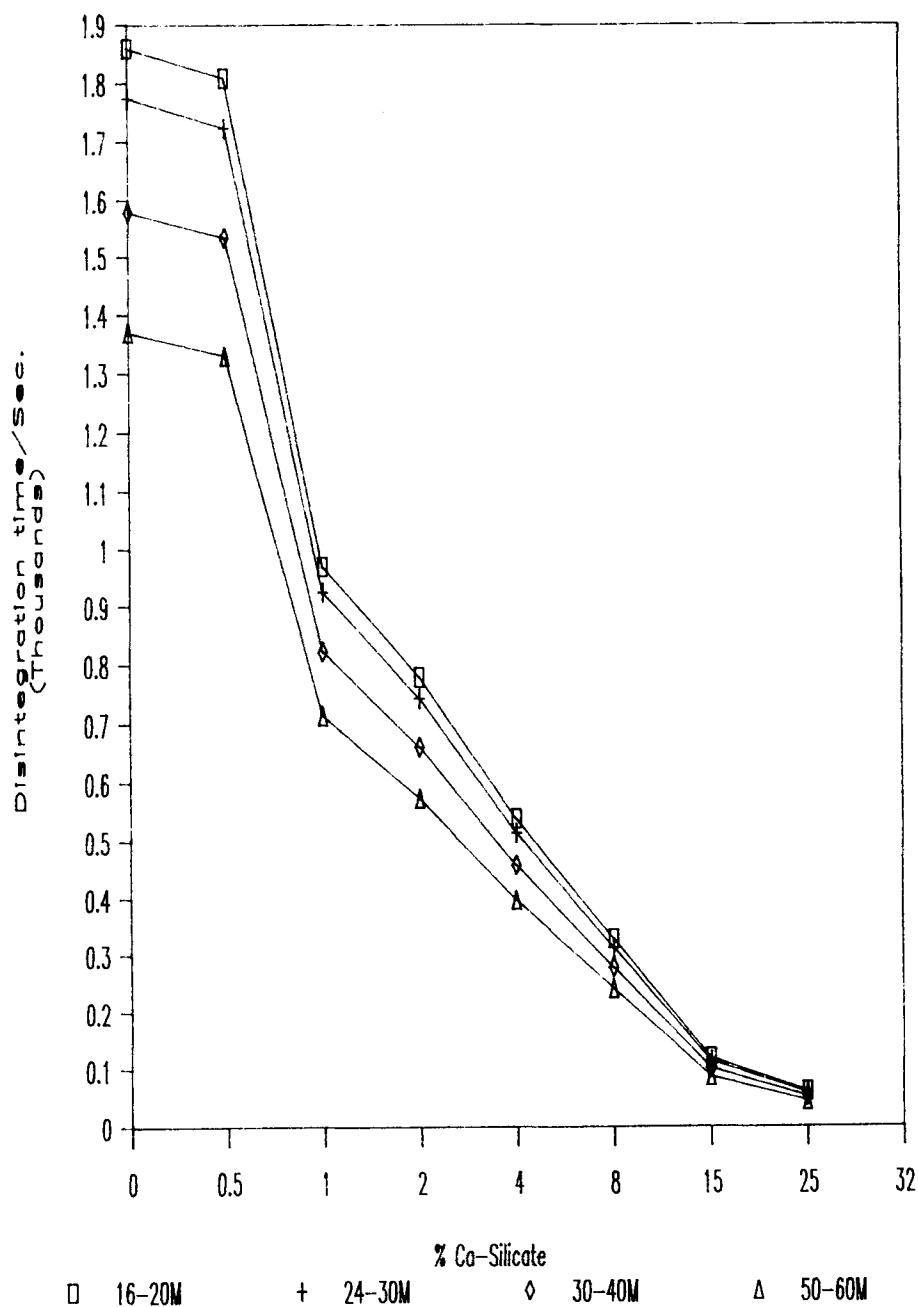


FIG. IV: Disintegr. of Co-Silicate

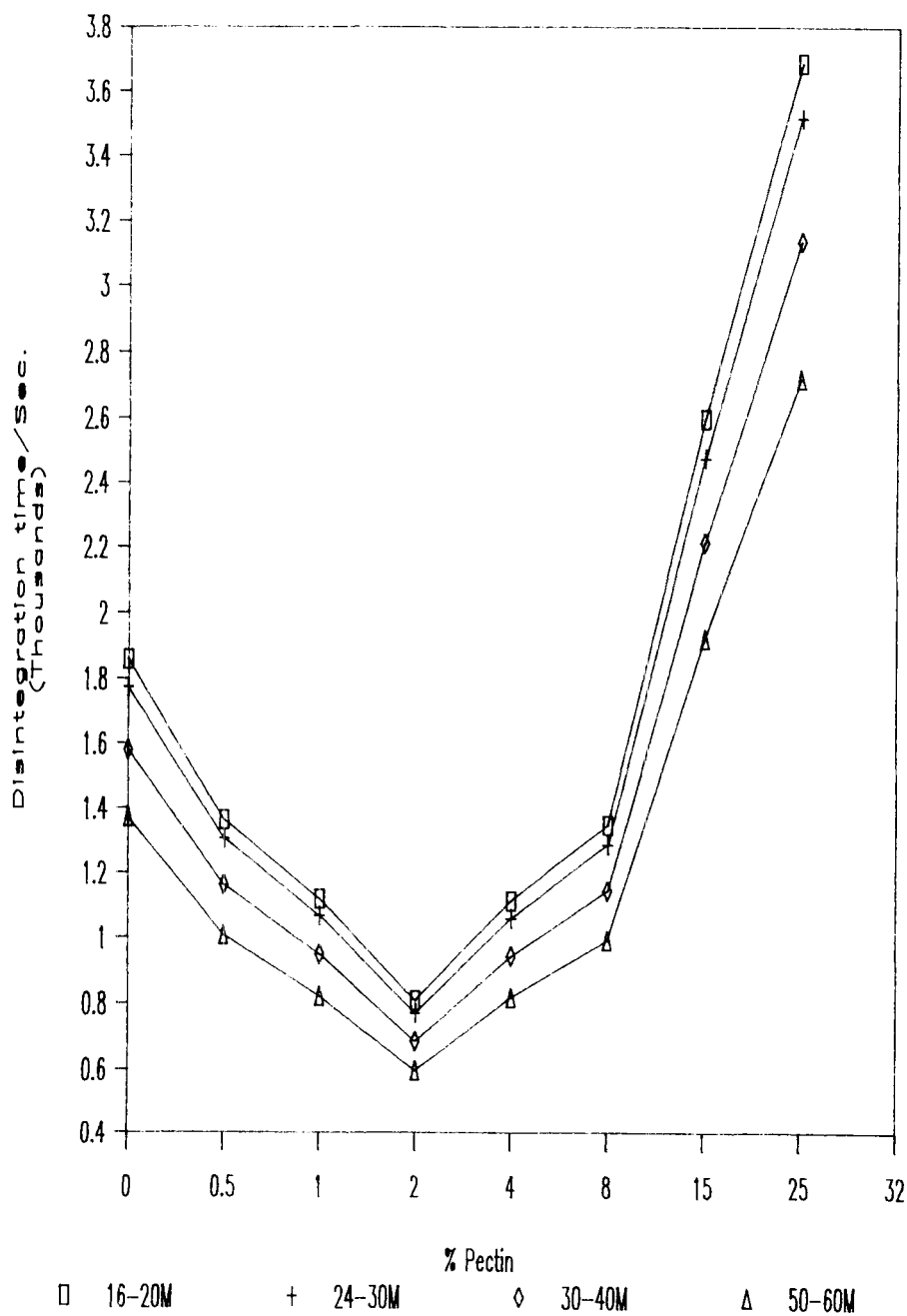


FIG.V: Disintegr. of Pectin

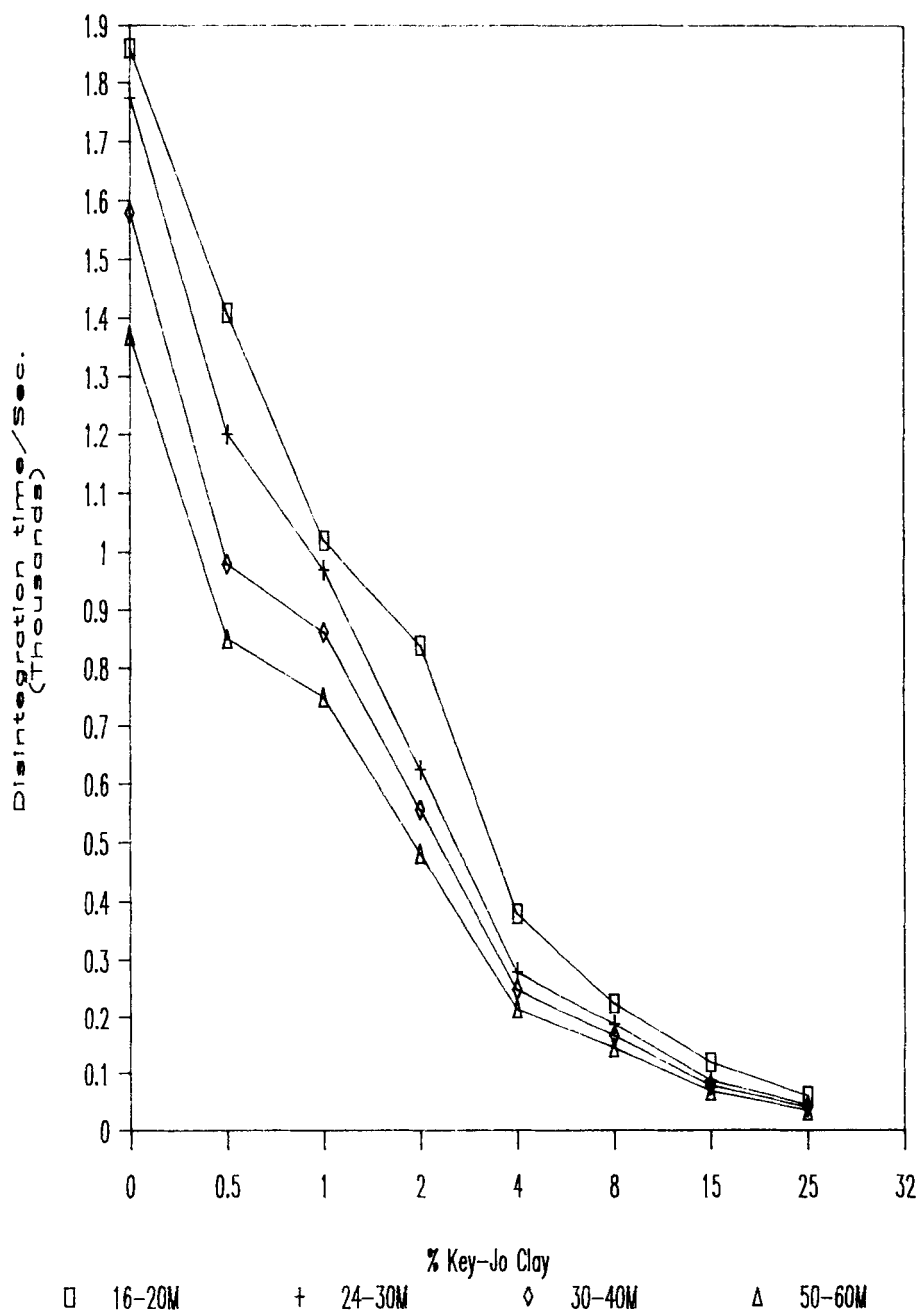


FIG.VI: Disintegr. of Key-Jo Clay

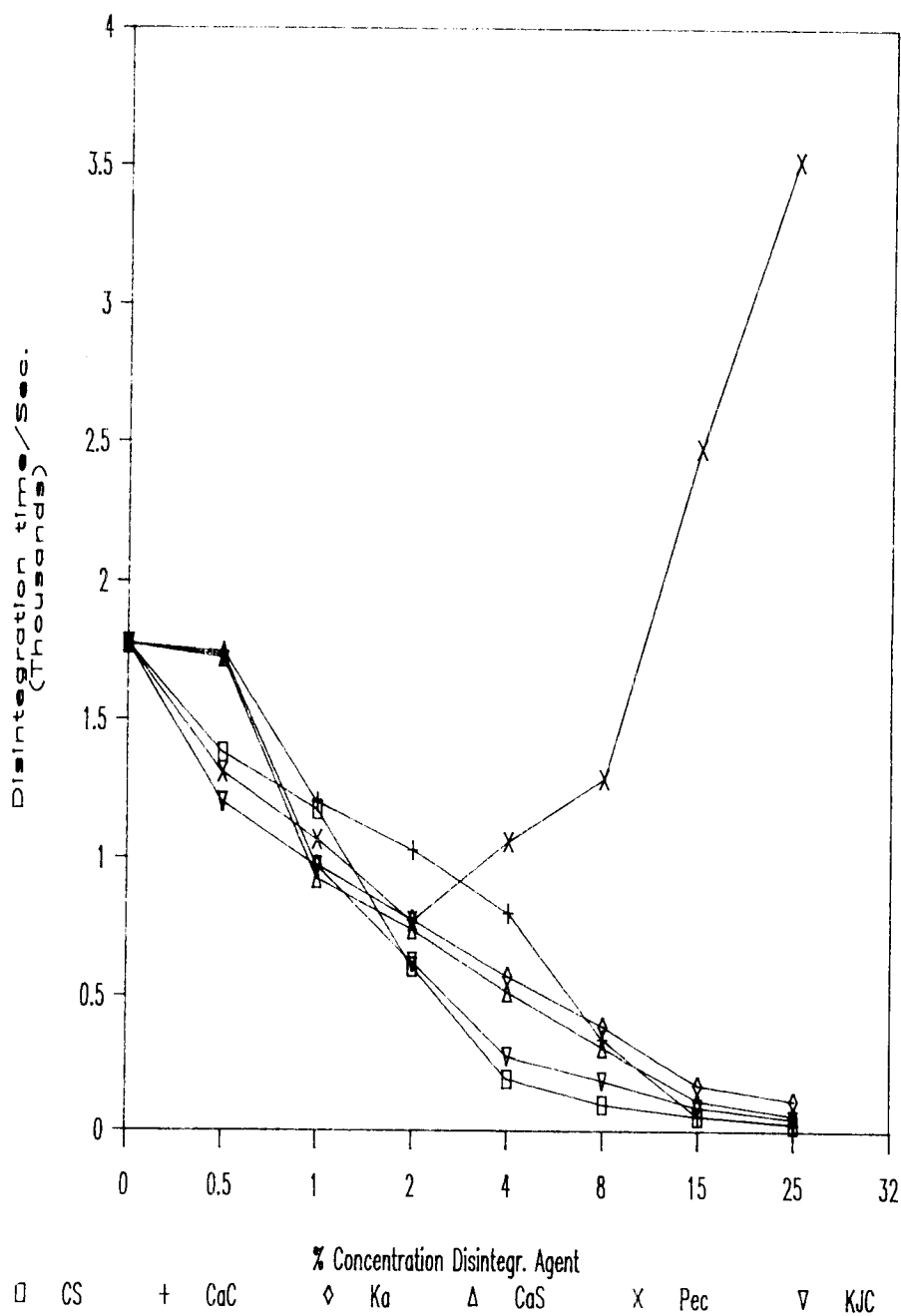


FIG.VII: Disintegr. time (24-30m)

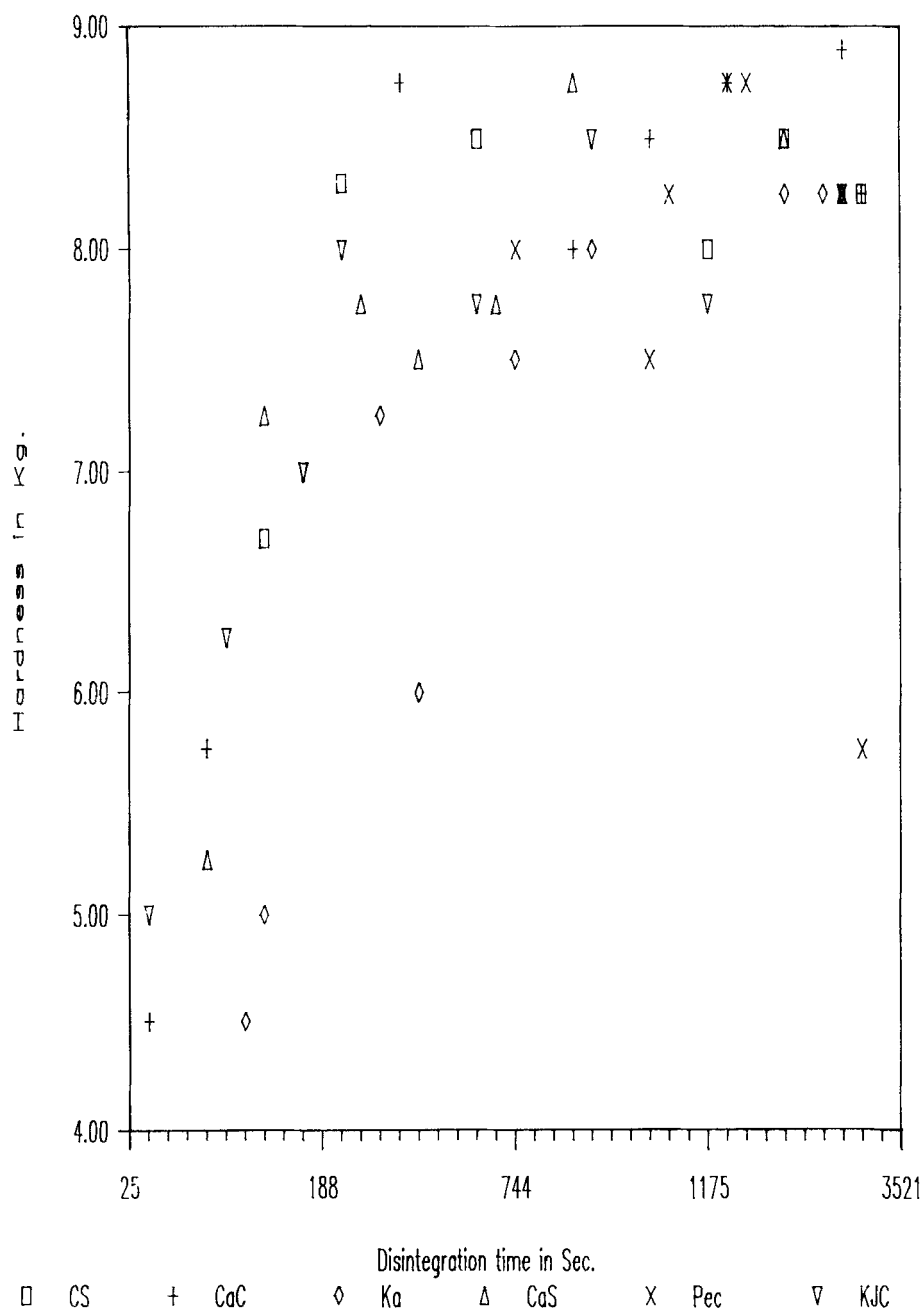


FIG. VIII: Corelation Diag. Hard. vs Time (24-30m)



When more than 15 percent of calcium carboxy methyl cellulose was added as the tablet disintegrator, the hardness became soft. See Figure 2.

Figure 3 shows that when more than 4 percent of kaolin was added as the disintegrator, the hardness was exceptionally decreased.

Calcium silicate as the disintegrator was harder than others, but the hardness of the tablet decreased considerably when concentration increased as Figure 4 shows.

In the case of Key-Jo Clay, the hardness was not greatly reduced like the others even when the concentration was increased to 25 percent of the tablet weight and had 5 kg of hardness. See Figure 6.

Figures 7 and 8 show the results of comparing the hardness and disintegration time of the tested tablets of each different percentage concentration of disintegrator with the same granule size of 24-30 meshes.

### CONCLUSION

Corn starch is a good tablet disintegrator, but it cannot be recommended when added as more than 8 percent of the tablet weight. Calcium carboxy methyl cellulose can be used as a tablet disintegrator, but concentration must not exceed 15 percent of the

tablet weight. Kaolin and pectin are not suitable tablet disintegrators because of the long disintegration time and higher hardness when concentration exceeds more than 8 percent. Key-Jo Clay was the most suitable tablet disintegrator among those tested even when added until it was 25 percent of the tablet weight, and the tablet was harder than the others although the disintegration time was not varied from the others.

#### ACKNOWLEDGMENTS

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#### FOOTNOTES

1. T.K. Shiro, J. Pr. Ph., 11, 31, (1960).
2. M.S. Chun, personal communication.
3. I.T. Chang, personal communication.
4. H.M. Gross and C.H. Becker, J. Pharm. Sci., 41, 157, (1952).

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