the interval required to raise the temperature from ambient to deactivation level, even though this interval is kept as short as possible. One might also speculate that another way to avoid the unwanted reaction would be to remove all possible moisture from the seed prior to crushing. Unfortunately, this is only a partial solution, since a certain level of moisture is as necessary as elevated temperatures for enzyme deactivation. With very low moisture, the hydrolysis certainly is minimized. However, myrosinase survives to cause problems at some later stage, particularly in the meal when adequate moisture level for hydrolysis may occur again.

SOLUTIONS

Agra's efforts have been directed along two fronts and are discussed below. We have increased our heating capability particularly in the early stages of cooking or conditioning. The object here being to minimize the time element required to exceed the deactivation temperature. To this end, we use large diameter stack kettles operating with as shallow a level of furnish as practical. Moisture content of the furnish as it enters the top kettle averages ca. 9%, and the top one or two kettles are not vented. After deactivation, the material is cooked further at 200 F and dried to a moisture content of 4 or 5% prior to pressing. We have found that, for good caking, the moisture level is quite critical within quite narrow limits.

Our objectives for the screw press cake are to have it contain 12-16% oil and not more than 5 or 6% moisture, which together with satisfactory physical structure, enables us to have good percolation of hexane through the bed in the extractor.

Canadian plant breeders recently have produced a number of varieties of rapeseed with very low levels of glucosinolate material. By largely eliminating glucosinolates, the development of processing techniques to accomplish enzyme deactivation now appears redundant. Our company cooperated with other crushers, the Canada Department of Agriculture, as well as the Canadian Rapeseed Association, in the growing of limited quantities of these varieties in 1973. A proportion of this production was allocated for experimental crushing, processing, and feeding trials. Most western Canadian crushers were involved in the crushing trials and found that these new varieties of rapeseed had entirely different crushing characteristics from those previously processed. The seed behaved differently in all stages right from flaking through prepressing to solvent extraction. All crushers reported similar behavior and results. It is obvious that we have a new ballgame on our hands which must be played and won. The stakes are high, and there is no question that techniques can and will be found to process this much improved seed.

Turning to the solvent extraction of prepressed rapeseed cake, we have not had good experience with flaking of press cake. Flaking has produced a fine granular type of product which has very poor percolation properties. For a time, we used a mild pulverizer with mixed results, insofar as percolation was concerned. We now do not treat the cake but merely convey it directly to the seal conveyor which feeds the extractor. This conveyor seems to break up the cake sufficiently to produce good percolation and acceptable extraction results. We have examined separately the fine and coarse meal coming off the meal cooler and, in general, find little difference in residual oil content. Only minor amounts of the coarse material would be retained on a quarter in. screen. Data does, however, show that a threshold or plateau of bound or unreleased oil still remains in both the fine and coarse material. We have released this bound oil only in the laboratory by extremely fine grinding prior to extraction in the Goldfisch extraction apparatus. In my opinion, it is very questionable whether this bound oil can be recovered practially in a commercial process. A further question is the true nature and composition of this material.

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[Received September 3, 1974]

Temperature and Frequency Dependence of Ultrasonic Velocity and Absorption in Sperm and Seal Oils

ABSTRACT

The variation of ultrasonic velocity and absorption in sperm oil and seal oil with temperature range of 5-55 C and frequency range of 1.5-60 MHz are measured. In both oils, the velocity increases ca. linearly with decreasing temperature and increases with increasing frequency; the absorption increases not only with decreasing temperature but also with decreasing frequency.

TABLE I

Some Chemical and Physical Properties

Property	Sperm oil	Seal oil
Water content and volabiles	0.10%	0.46%
Impurity	0.72	0.68
Acid value	0.04	0.05
Iodine value	79.1	141.1
Peroxide value	13.5	59.5
Saponification value	131.4	195.4
Unsaponifiable (percent)	38.20%	1.28%
Mp	11 C	5 C
Refractive index, N^{40}	1.457	1.470

INTRODUCTION

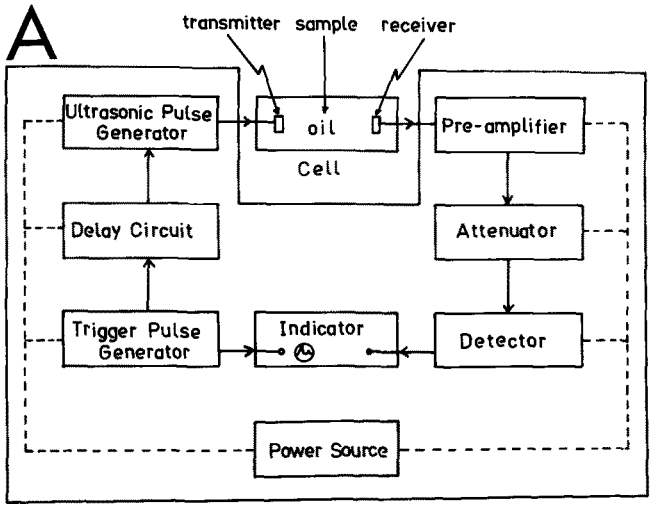
In recent years, many authors have published the temperature and frequency dependence of ultrasonic velocity and absorption in liquids, solutions, polymeric substances (1-3) and high viscosity plant oils (4-8). However, there is little data about the oils of sea animals. In the present paper, the authors report the experimental results of the temperature and frequency dependence of ultrasonic velocity and absorption in sperm and seal oils. Some

TABLE II

Density and Viscosity

Temperature (C)	Sperm oil		Seal oil	
	Density (g/cm^3)	Viscosity (CPS)	Density (g/cm^3)	Viscosity (CPS)
5	0.882	405	0.929	280
10	0.880	242.5	0.925	175
15	0.875	62.5	0.922	132.5
20	0.870	45	0.917	105
25	0.866	37.5	0.912	75
30	0.864	32.5	0.908	54
35	0.862	25	0.906	44.5
40	0.858	21.5	0.905	37.0
45	0.856	19.0	0.903	30.5
50	0.853	16.5	0.900	27
55	0.849	15	0.896	23.5

CPS = centipoises.



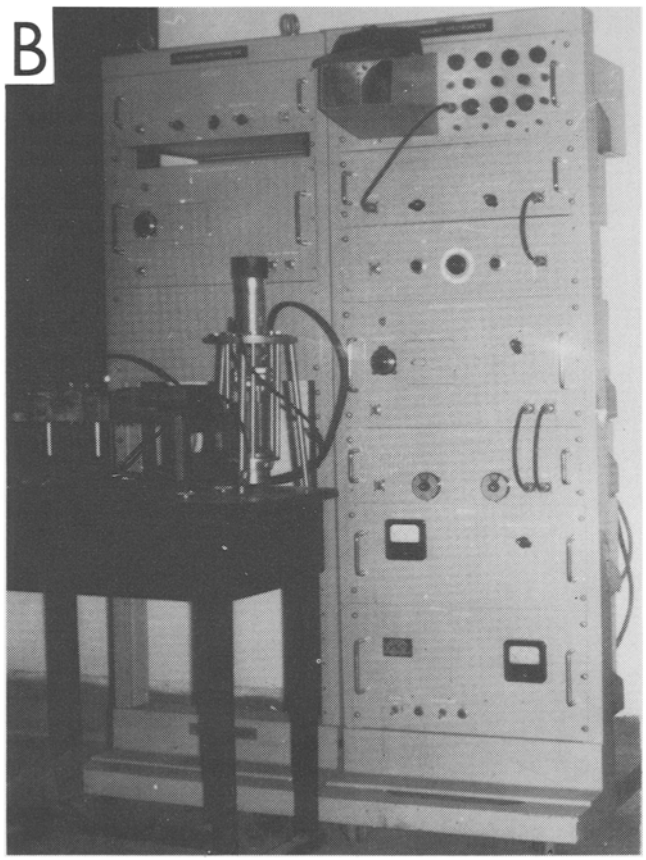


FIG. 1. A. Block diagram of the principle of ultrasonic spectrometer. B. Photograph of ultransonic spectrometer.

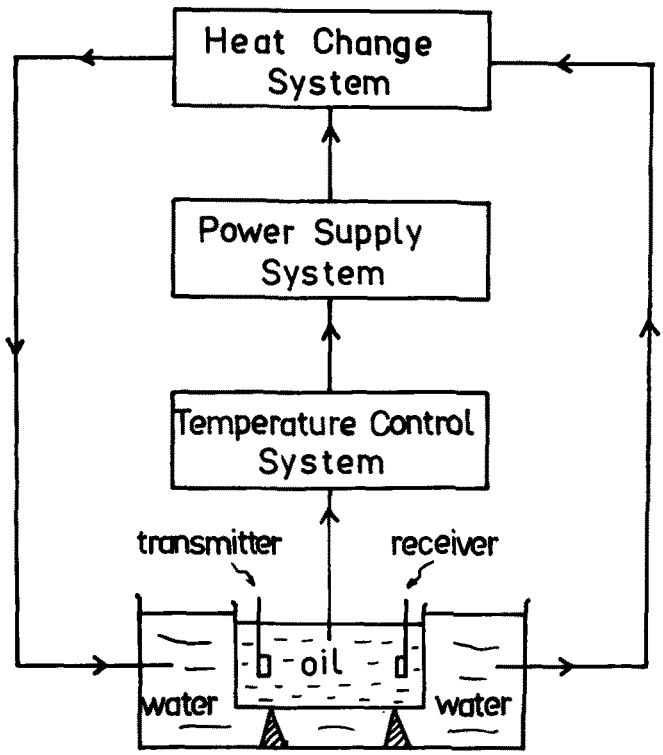


FIG. 2. Block diagram of the principle of Coolnics circulator.

chemical (9,10) and physical properties of these two oils were tested and are listed in Table I and Table II.

EXPERIMENTAL PROCEDURES

On our experiment, we used pulse method (11) (Fig. 1) with ultrasonic frequency range of 1.5-60 MHz. The temperature was controlled by Coolinics circulator (Fig. 2) in the range 5-55 C. The velocity of propagation was determined by a direct measurement of the time duration from one pulse to the next. The absorption was determined by the decrease of the received pulse amplitude as the distance between transmitter and receiver was increased.

To limit errors due to the oxidation of oils and due to pulses, such as form distortions, special care, such as the following, has been taken: (A) the container and experimental vessel were put in nitrogen gas during the measurement; (B) the distance between two transducers (transmitter and receiver) was kept in the Fresnel's region (12); (C) temperature gradient and mechanical fluctuation in the oils was avoided; and (D) the transmitting and receiving transducers always were parallel to each other when the distances between them were changed.

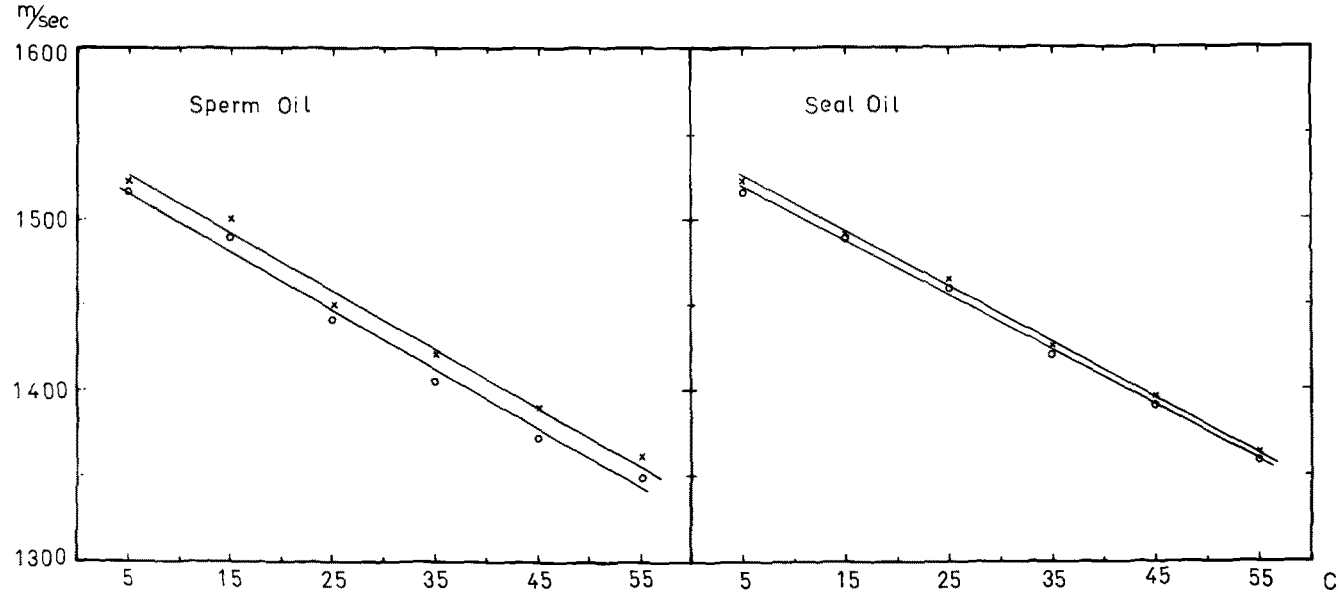


FIG. 3. Sperm oil and seal oil velocity (m/sec) vs. temperature (C). x = 60 MHz, o = 1.5 MHz.

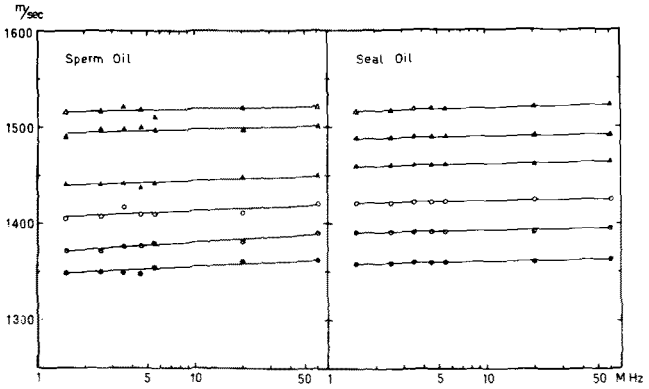


FIG. 4. Sperm oil and seal oil velocity (m/sec) vs. frequency (MHz). △ = 5 C, ▲ = 15 C, ▲ = 25 C, ○ = 35 C, ⊘ = 45 C, and ● = 55 C.

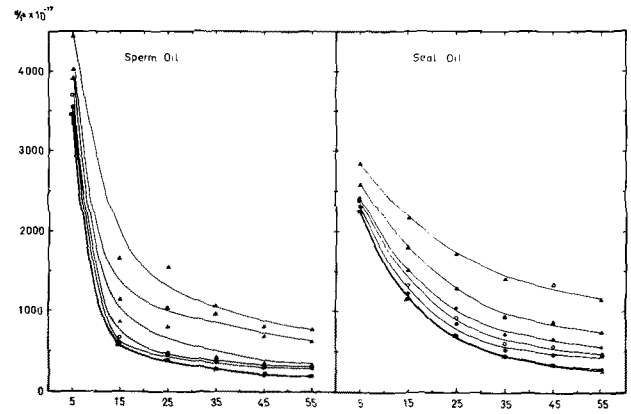


FIG. 5. Sperm oil and seal oil absorption coefficient/frequency square (α/f^2, sec^2/cm) vs temperature (C). △ = 1.5 MHz, ▲ = 2.5 MHz, ▲ = 3.5 MHz, ○ = 4.5 MHz, ⊘ = 5.5 MHz, ● = 20 MHz, and X = 60 MHz.

RESULTS

From the experimental results, it is found that: (A) the ultrasonic velocity increases with decreasing temperature for each frequency (Fig. 3) and increases almost linearly with increasing frequency at each temperature (Fig. 4); and (B) the ultrasonic absorption ($\alpha/f^2 \times 10^{-17}$) increases with decreasing temperature for each frequency. The rate of change is rather small when the measuring temperature is far from the mp, and the rate of change becomes larger if the measuring temperature is near the mp (Fig. 5 and Table I). The absorption also increases with decreasing frequency at each temperature and remarkably when the frequency decreases from 2.5-1.5 MHz (Fig. 6).

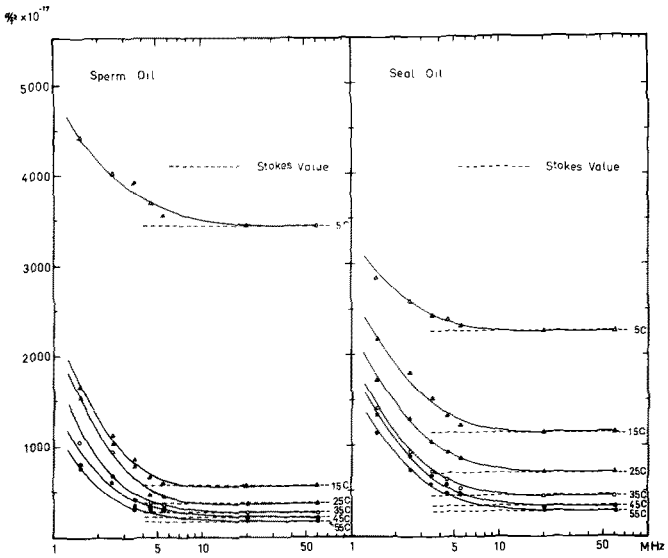


FIG. 6. Sperm oil and seal oil absorption coefficient/frequency square (α/f^2, sec^2/cm) vs frequency (MHz). △ = 5 C, ▲ = 15 C, ▲ = 25 C, ○ =35 C, ⊘ = 45 C, and ● = 55 C.

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[Received March 18, 1974]