been approved by the FDA. However it was approved by these states and was legal if not shipped in interstate commerce. Preliminary studies using Bisulfite for detoxification of aflatoxin were reported. It was noted that little is known concerning the detoxification of other important mycotoxins such as DON (Deoxynivalenol, zearalenone, cyclopiazonic acid and T2 toxin, and these studies are desperately needed.

Finally, the third topic prevention was discussed both from both preharvest and postharvest viewpoints since unlike insect pests the same toxin producing fungi (*Aspergillus flavus* and *A. parasiticum*) attack oil seeds and grain both in the field and subsequently in the warehouse. In the case of preharvest aflatoxin contamination of peanuts, corn and cotton seed is directly associated with drought stress during the latter portion of the growing season. It appears that no aflatoxin forms in peanuts in the absence of drought stress even though significant invasion by aflatoxin producing fungi may occur.

The session finished with a lively discussion on the role of lypoperoxidation on aflatoxin biosynthesis. In *vivo* aflatoxin biosynthesis is enhanced by the addition of chemicals that induce lypoperoxidation within fungi. The possibility of using additives of BHA, BHT, TIO and cysteamine to inhibit aflatoxin biosynthesis in grain and oil seeds was discussed.

Although not directly related to the assigned topic there were some discussions on the effects of aflatoxin in human health particularly in developing countries. Also it was noted that the lowering of levels acceptable in developed countries may selectively affect levels approved in developing countries.

ROUNDTABLE V. ADVANCES IN THE USE OF MODIFIED ATMOSPHERES FOR STORED PRODUCT PROTECTION

Discussion moderator: C.H. Bell, U.K.

Currently three approaches for storage strategies based on modification of the atmosphere in structures not hermetically sealed were recognised. Firstly nitrogen could be used as a replacement atmosphere, supplied either by bulk transport or by on-site generation from compressed air; secondly carbon dioxide supplied either in bulk or from cylinder banks can be used, and thirdly there was the gas generated by combustion or catalytic convertion of hydrocarbon fuels.

Discussions commenced with nitrogen, which of the three alternatives had hitherto been regarded as the least promising avenue of approach. Compared to other atmospheres nitrogen on balance required longer exposures to kill pests, especially at lower temperatures, and only remained effective if the oxygen content of the atmosphere remained well below 2%. Thus in the case of a total atmosphere replacement within a storage structure the maximum rate of leakage that could be tolerated within the intended period of exposure was less than 10%. Hence the use of nitrogen was recognised to be restricted to very gas tight structures or to systems based on the continual production of gas. Because of these limitations nitrogen was not able to compete with carbon dioxide, effective against insects down to 40% in air, if supplied by bulk transport. Howver some recent advances in the field of molecular seive technology were discussed and it appeared that the capital costs of nitrogen generating plants were falling while improvements had been achieved in the capacity to provide an atmosphere containing less than 0.5% oxygen. Formerly the output rate had to be drastically reduced to produce such an atmosphere and costs were increased. The recent improvements reduced the economic advantages of other atmospheres over nitrogen.

The use of carbon dioxide was discussed in some detail starting with the problem of corrosion of steel in carbonated concrete. Much carbon dioxide was sorbed by newly made concrete and this increased the porosity of the structure to damp, although the carbonation process actually improved tensile strength. Older structures had become carbonated by sorption of CO_2 from the atmosphere over long periods of time. Uses of carbon dioxide extended beyond the field of atmosphere replacement in that its presence improved the distribution and toxicity of fumigants. It was also used as a dispersant of pesticides. Atmospheres containing a large proportion of CO_2 replaced the interstitial space in grain very efficiently and often a structure was purged as far as the head space by a single replacement of the interstitial volume. Carbon dioxide as a toxicant retained more of its effectiveness than other atmospheres as temperatures were lowered, and appeared suitable for use in cool conditions. Some oxygen needed to be present for the gas to be fully effective against pest species.

The many different structures in existance permitted several lines of approach for use of carbon dioxide. Well sealed larger storages can be treated by a single application of CO_2 from a bulk supply, either road tanker or on site storage as with CO_2 a 60% leak-back could be tolerated during the treatment. Many structures however, do not meet the pressure test standard used in Australia of 2" water gauge decaying to 1" in not less than 5 minutes, and are only suitable for CO_2 treatment if a top-up of gas is maintained. With a pressure standard of 2" falling to 1" in one minute the level of top-up required is about one atmosphere replacement every 2-3 days. Gas for smaller storages could be supplied from banks of cylinders rather than from bulk tanks.

One problem that could be crucial to CO_2 use is the fact that some species are able to develop a degree of resistance to the gas. So far a factor of x6 had been noted for Tribolium castaneum. Resistance of a different type has also been obtained by selecting for tolerance to low oxygen levels. At the conference the use of carbon dioxide was still regarded as an attractive proposition, depending mainly on its local availability.

The third atmosphere considered was that produced by combustion of hydrocarbon fuels. This method of providing gas avoided the need for bulk-transport of liquid carbon dioxide or nitrogen, and only the smaller volume of the fuel had to be brought to the treatment site. The capital cost of the burner was at present high but new data on the parameters of the atmosphere required gave every prospect for the development of a lower cost apparatus. With propane as fuel an atmosphere can be produced containing about 13% CO_2 and less than 1% oxygen. Some sorption of CO_2 occurs in the grain but the generated gas, like pure CO_2 replaces interstitial air with a single change of the atmosphere. The level of CO_2 in the gas is also of importance in synergising the effect of the low oxygen level against insect pests.

In conclusion it was noted that in many situations the use of an on-site generated atmosphere offered the cheapest method of using controlled atmospheres for insect control. Carbon dioxide at about 60-80% in air, was the atmosphere most effective against pests but needed a supply system for practical use. It did have potential in parts of the world where dense population was accompanied by industrial development. The current downward trend in prices for molecular seives improved the prospects for the use of nitrogen and the development of membrane filter based extractors in the future offered a new dimension to controlled atmosphere storage.

ROUNDTABLE VI. AERATION AND COOLING FOR IMPROVING GRAIN STORABILITY

Discussion moderator: M.R. Sartori, Brazil.

Topics discussed during the roundtable were:

In humid and hot climates where there are slight fluctuations of temperature between day and night, the roundtable participants were in agreement that aeration as a general rule, should not be recommended for bulk stored grain. Under these conditions it is extremely important that dried grain received for storage should be protected against moisture reabsorbtion and excessive heating. Silos should be shaded or have walls and roof with sufficient insulating power to protect the product against excessive heat. If drying facilities are not available humid products should be stored in loose stacks in warehouses with good air circulation. The air circulation in those warehouses could be improved by the construction of wind catching devices in the roof in order to take maximum advantage of prevailing day and night winds.

Another possible emergency situation for stacks of humid grain would be to have a polyethylene sheet wrapped tightly around the stack leaving the bottom uncovered. A fan connected to the top of the stack would suck the air through the stack and blow it to the outside.

Aeration of bulk stored dry grain, when the R.H. of the air is high, as a general rule would be possible if there is at least 6°C difference between the ambient air and the grain temperature. However, after the grain has been cooled, moistening may occur if humid and warm air is moved through the grain bulk.

Aeration was defined as the movement of air through the grain bulk to preserve the grain quality and improve storage conditions by preventing moisture migration and lowering the grain temperature.

Aeration with chilled air would reduce the temperature of the grain to the range of 10-15°C. The energy consumption would be 3 to 5 kwh/ton for one pass during the summer. Cooling of the grain should be done as soon as possible after harvesting. Temperatures below 17°C