

Questions and Answers on AK-33X

1. What is Ethyl's new antiknock?

It is a chemical compound called methyl cyclopentadienyl manganese tricarbonyl. It is a new organo-metallic compound discovered by our research chemists. It consists of a manganese atom connected to three carbonyl groups and one methyl cyclopentadienyl group. It is a very stable compound and about one-quarter of the total weight of the compound is manganese. The compound, which we have designated AK-33X is a straw-colored liquid with a density of 1.4 and boils at 451 degrees F. and freezes at 34.6 degrees F. It is miscible with hydrocarbons and its solubility in water (70 parts per million) is sufficiently low so that it is a suitable additive for gasoline.

2. Briefly, how does it work?

AK-33X performs its function as an antiknock by decomposing into fine particles of manganese oxide, mainly Mn_2O_3 and Mn_3O_4 . These particles then control the rate of oxidation of the fuel in the same way that lead oxide particles work in the case of TEL. In both the case of AK-33X and tetraethyl lead, it is the decomposition products of the chemicals which perform the antiknock function and which slow down the very rapid combustion which results in knock. The use of the complicated molecule is to provide the manganese in a soluble form of the proper stability to provide the manganese at the proper time in the internal combustion cycle.

3. In what concentrations will it be used?

Samples of AK-33X are being offered to oil companies so they can determine its antiknock effectiveness in base stocks. On a weight of metal basis, we would suggest that its effectiveness be investigated over a range of 0.1 gram of manganese (.2953 ccs of AK-33X) to 1.0 gram of manganese (2.953 ccs of AK-33X) when used in conjunction with 3 ml. of tetraethyl lead, and a range of 0.25 gram to 2.0 grams when investigated as a primary antiknock. The atomic weight of manganese is 54.94 and that of lead is 207.21.

4. How effective an antiknock is the new compound?

The effectiveness of the new antiknock compound varies widely in different base stocks. It is more effective under Research method rating conditions than under Motor method rating conditions, and it is most effective in those fuels which have good response to TEL. It is less affected by the common antiknock antagonists, such as sulfur, than is tetraethyl lead. AK-33X is in general about twice as effective as tetraethyl lead, based on Research method ratings.

5. Will it be used in conjunction with tetraethyl lead?

AK-33X may be used first in aviation gasoline, and, if so, will be used in conjunction with tetraethyl lead. We would also anticipate that if it were to be developed to a commercial antiknock compound for motor fuels, it would likewise be used in conjunction with tetraethyl lead.

6. What is Ethyl's patent position?

Ethyl has applied for patent coverage on this compound and related materials as such. Coverage is also being sought for use of the compound as a gasoline additive and also for methods of manufacture.

7. What do the Curtiss-Wright tests show?

Tests in a full-scale Wright R-3350 Turbo Compound engine indicate that the use of this new antiknock as a supplement to TEL in 115/145 aviation gasoline will enable aircraft to cruise faster, carry larger payloads, fly at higher altitudes and exhibit improved fuel economy. Results indicate large potential power increases up to 20% for take-off, climbing and cruising, without changing engine size.

8. What can be said about its use in motor fuels?

AK-33X appears to be economically attractive in motor fuels as well as aviation fuels. However, its usefulness in motor fuels will be dependent upon two things: First, the successful development of corrective agents which will overcome the problems of utilization, such as the effect on valve and spark plug life; and second, upon the attractiveness of the compound from an antiknock effectiveness standpoint in each individual refiner's fuels. There are indications that the problems of corrective agents can be satisfactorily solved.

9. Will this product be compatible with most gasolines and gasoline additives?

Indications are that there will be no stability problems with AK-33X in most gasolines under limited storage. Under long storage conditions, antioxidants may be desirable. AK-33X is compatible with commonly used phosphorus additives, but we have not investigated its compatibility with all additives in gasoline used by all oil companies.

10. What is the effect of the compound on lubricating oil additives?

Using engine cleanliness and bearing life as criteria, there is no indication that the new antiknock compound has any deleterious effects on lubricating oil. However, similar to the case of gasoline additives, we have not investigated all lubricating oil additives and all lubricating oil stocks.

11. Will the new compound affect surface ignition?

It appears that AK-33X will have little effect on surface ignition due to deposits. Higher concentrations, however, may have a beneficial effect on some forms of surface ignition.

12. What are the engine durability problems facing the new compound for automotive use?

In certain concentrations and under certain operating conditions, there are problems with both spark plugs and valves. Where AK-33X is used in conjunction with tetraethyl lead, the major engine durability problems concern exhaust valve life under moderate and heavy-duty operating conditions, exhaust valve lash loss under heavy-duty conditions, and spark plug fouling under heavy-duty conditions.

In passenger cars, the durability problems with AK-33X as a primary antiknock concern spark plug fouling. In heavy-duty service, valve lash loss and spark plug fouling will be the major problems.

13. What are its effects, good and bad, on spark plugs?

When AK-33X is used in conjunction with tetraethyl lead in fuels containing ordinary sulfur concentrations, the addition of a small amount greatly lengthens spark plug life under light metropolitan operating conditions. On the other hand, under heavy-duty conditions, and in some concentrations, spark plug life is shortened by the addition of AK-33X to leaded fuels. Under these conditions, deposits build up which bridge the gap between the electrodes. This effect also takes place at higher concentrations when AK-33X is being used in the absence of any corrective agent.

14. What further research and development work does Ethyl plan?

We will continue extensive research in three major fields:

- a. Development of a satisfactory corrective agent for spark plugs and valves when AK-33X is used in motor fuels.
- b. Investigate fundamental relationships of the effectiveness of AK-33X in various hydrocarbons.
- c. Develop improved manufacturing processes.

15. What experimental quantities of the new compound will be made available to refiners?

A pint sample of the compound, containing approximately 475 cc's of AK-33X, will be made available immediately to all customers wishing to do laboratory testing of the compound. These pint cans will be shipped in sealed outer containers essentially the same as now being used for laboratory cans of "Ethyl" fluid. The TEL precautions, listed on the outer containers, also apply to the new compound. For the present, we have temporarily removed the "Ethyl" emblem from these outer containers of the sample quantities of AK-33X.

16. Will Ethyl check experimental gasoline samples containing the new compound submitted by customers?

We are not equipped to test aviation gasoline samples. We will gladly test motor gasoline samples within the limits of our facilities. This testing will not, however, be permitted to interfere with our testing work in connection with our regular monthly surveys and other normal operations. A more detailed memorandum on this subject is being supplied by the Gasoline Testing division.

17. Is the material toxic, and how should it be handled?

AK-33X has a toxicity which is fairly comparable to that of TEL. It is absorbed into the body in the same manner as is TEL, and it presents essentially the same practical problems as those with which we are familiar in the case of TEL. In handling and shipping it, the application of our general TEL precautionary and regulatory procedure will be entirely satisfactory, as far as can be presently determined.

In mixing it with gasoline, AK-33X for the time being will be handled only in laboratory quantities for evaluation purposes. The same regulations governing the laboratory handling of TEL, including the use of hoods and protective equipment for laboratory personnel, must also be followed in the case of AK-33X.

18. How will its price probably compare with tetraethyl lead?

It is not expected AK-33X can be produced at a price which will make it competitive with TEL in most gasolines. With corrective agents, AK-33X will compete with refinery processing rather than TEL.

19. What will be the effect of the new compound on TEL use?

We can't tell as yet what the ultimate effect will be. However, because it complements the antiknock effect of TEL, we believe it will strengthen the role of antiknock additives in providing octane number.

20. What raw materials does it use?

The raw materials used are methyl cyclopentadiene (a component of some refinery streams), sodium, manganous chloride and carbon monoxide.

21. What are Ethyl's plans for production?

We have worked out a manufacturing process for AK-33X in the laboratory and a small pilot plant. If there were an urgent demand, we could use equipment installed at our Orangeburg, S. C., experimental products plant to produce AK-33X for aviation fuel. It is too early to set dates when and where we could have large-scale manufacturing facilities in operation.

22. Does the new compound have any foreseeable effect on our present TEL manufacturing operations?

As far as we can presently determine AK-33X will have no foreseeable effect on our TEL manufacturing operations.

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23. Does the new compound have any effect on our new San Francisco plant being built or on our recently announced new TEL method?

No. The San Francisco plant and the new TEL method are completely separate developments. The San Francisco plant is being built in response to the growing needs of West Coast refiners. The new TEL chemistry is part of our continuing research and development method to improve our existing manufacturing processes and to develop better ones if possible.

24. Why is it being announced now?

Primarily we are announcing AK-33X now because of its critical importance to the further development of aircraft piston engines. Equally important, we are revealing it now to permit the petroleum industry to consider its possibilities as a supplement to TEL in connection with its forward planning of refinery operations and processes.

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