EGG-M-01987
CONF-870217--1

WASTE TIRES AS AUXILIARY FUEL FOR CEMENT KILNS

EGG-M--01987

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Work Supported by the U.S. Department of Energy
Assistant Secretary for Conservation and Renewable Energy
Office of Industrial Programs
Washington, DC
Under DOE Contract No. DE-AC07-76ID01570

The subject I have been asked to speak about is the utilization of scrap tires as an auxiliary fuel for cement kilns. My experience with scrap tires began five years ago when we performed a technical and economic evaluation for tire pyrolysis. I work for the Idaho National Engineering Laboratory which is supported by the Department of Energy. My interest in scrap tires continued; in 1984 the Department of Energy and the Portland Cement Association jointly sponsored a conference on the utilization of scrap tires in cement kilns. Most of my remarks today are based upon that conference along with some current information in the U.S.

Mr. Sladek requested that I speak on the combustion process, the progress to date, and the factors that impede or encourage implementation of using scrap tires in cement kilns. For discussion purposes it would help if we had a common understanding of the cement manufacturing process. Cement is made by heating a mixture of finely ground limestone and silica from clay or sand to about 1450°C in a large rotating kiln. The heat causes the limestone to decarbonate and subsequently react with the silica to form calcium silicates. A diagram of cement manufacture is shown in Figure 1. The length of the kiln is very long (some are over 300 ft long). In recent years, preheaters and precalciners have been added to newer kilns. The effect of the preheater or precalciner is to reduce the length of the kiln.

The preheater or precalciner is stationary; more importantly up to 60% of the fuel requirements can be added to the precalciner while only 10% of the fuel requirements can be added to the preheater. In Germany and Japan, 15% to 20% whole scrap tires are substituted for conventional fuel (coal) usually in kilns with preheaters or precalciners.

The data about production capacity in the U.S. shows that actual capacity is 88 million tons per year. The depressed state of the industry would suggest that production per year is much less. The production capacity of kilns with preheaters or precalciners is about 37% of total production. Our discussion, today, will focus on these types of plants because tires can be added easily. The hottest zone of the kiln is in the middle, which is where the tire would combust completely. The whole kiln is rotating and there is no convenient place to insert tires in the long dry kilns. In the kilns with preheaters or precalciners, tires may be added easily with the current fuel without too many additional problems (the necessary air locks already exist). Most cement kilns converted to coal fuel during the last energy crisis. There are 48 plants in the U.S. that have preheaters or precalciners. If these plants each substituted 10% scrap tires as an auxiliary fuel, 40 million scrap tires could be used in one year. This represents 1/4 of the national waste tire generation rate. The approximate rule of thumb for generation rates is "One tire per person per year".

In Germany, the government mandated cleanup of the scrap tire problem. There are 6 plants that use 15-20% scrap tires as fuel. The percentage has been decreasing in recent years because too many plants were using tires, the dump sites were cleaned up, and the tread life of the tire has been increasing. The Japanese were the first to experiment with scrap tires in the late 70's. The Japanese import 99% of their fuel; any fuel substitution is widely appreciated. More recently in Japan, scrap tires have been bid up too high for the cement manufacturers. The scrap tires are being used to in cogeneration facilities to generate electricity.

In the U.S., one plant, owned by the Caleverias Cement Company (a Belgian Company), in Sacramento, California, burns 25 to 30 tons per day of scrap tires. The plant has a preheater; the tires are shredded to a very small size (5/8 in) and blown into the kiln with the coal. When the plant first began experimenting with scrap rubber, they could not get the shreds far enough into the kiln. It required a larger blower. Another plant in Arizona has been experimenting with scrap tires; their facility has a flash precalciner. Contacts have been initiated in the Midwest by a scrap tire dealer; he hopes to have a contract in place with a cement company by Spring, 1987.

The question of whether to use whole tires or shredded tires is a complicated question. Whole tires require a materials handling system which may require more capital than the cement companies are willing to risk. Shredded tires may be adapted to the cement company's current facility along with heir coal fuel. The issues of collection, storage, and transportation require some attention. The cement manufacturer is <u>not</u> in the tire collection and storage business. If shredding is required, the cement manufacturer is <u>not</u> is the business of shredding tires. The cement manufacturer requires a fuel that is similar to his current fuel (coal) and requires no additional expense. The bottom line is that tire brokers are needed to collect, shred (if necessary), store and deliver the tires. The cement company is in the business of cement manufacturing, <u>not</u> fuel collection.

The factors which impede or encourage progress include technical problems, supply problems, environmental barriers, economic barriers, perceived problems, and geography. The technical problems include tire quality and a mechanism to deliver the scrap tires to the kiln. When the Caleverias plant first began to experiment with scrap tires, their first supply of tires included water, lumber, rags, other trash, and an oil filter. Obviously the quality of the delivered material must be clean and similar to their current fuel. Various mechanisms to deliver the scrap tires to the kiln have been developed. A whole tire handling system was developed in Germany and has been used throughout Europe. The system is expensive and costs about one million dollars. Shredded tires may not require such expensive handling systems, but may require some modification to cement plants such as a larger blower.

The supply of scrap tires should not be a serious problem, but if a cement manufacturer is going to invest $1 million, supply must be assured. Even for shredded tires a constant steady supply is necessary before the cement company will be willing to take the risk. Environmental problems are difficult to evaluate. The test results in Germany show no know environmental problems. The test results at the Caleverias plant show no environmental problems. The baghouse collects the particulate; the steel from the tires becomes the ferrous oxide for cement manufacture. Specific tests on their collection samples showed no zinc, cadmium, arsenic, or antimony. The economic barriers are simple. For scrap tires to become acceptable to cement companies, they must compete successfully with coal. Nationally, coal sells for $42/ton; tires need to be significantly less. In the west, coal may be as low as $30/ton; tires will have to be less to be competitive and attractive to cement manufacturers.

The perceived problems are the "What if" problems. The current depressed state of the cement manufacturing industry means that there will be very few risk takers. What incentive is there for a cement manufacturer to experiment with a workable process. The economic incentive may be the only attraction.

Geographically, the large metropolitan areas contain the largest generation of scrap tires. At one tire per person per year, these areas would naturally have the largest generation rates and also have the largest scrap tire stockpiles. Interestingly, the cement manufacturing plants are also located within a close proximity to the large metropolitan areas. If we superimpose all three maps, there appears to be a good match between cement kilns, scrap tire generation, and scrap tire stockpiles. (Maps are attached as Figures 2, 3, 4, and 5.)

In the Denver area, there are two cement plants located within 55 miles. One plant has a precalciner, the other a preheater. They would be ideal candidates for using scrap tires as auxiliary fuel. The tire stockpiles in the area are estimated to contain about 12 million tires. The generation rate for Denver is about 1.6 million tires per year. At a substitution rate of 10% these two cement plants could easily use one million tires annually.

In conclusion, utilizing scrap tires in cement kilns as auxiliary fuel is technically feasible as demonstrated in Europe and Japan. There are no environmental problems according to the tests being conducted in California. There is a good match between tire generation rates (or population), scrap tire stockpiles, and cement kilns. In fact, substitution of scrap tires in cement kilns offers an excellent opportunity for assisting in abatement of the scrap tire problem.

Cement Manufacture

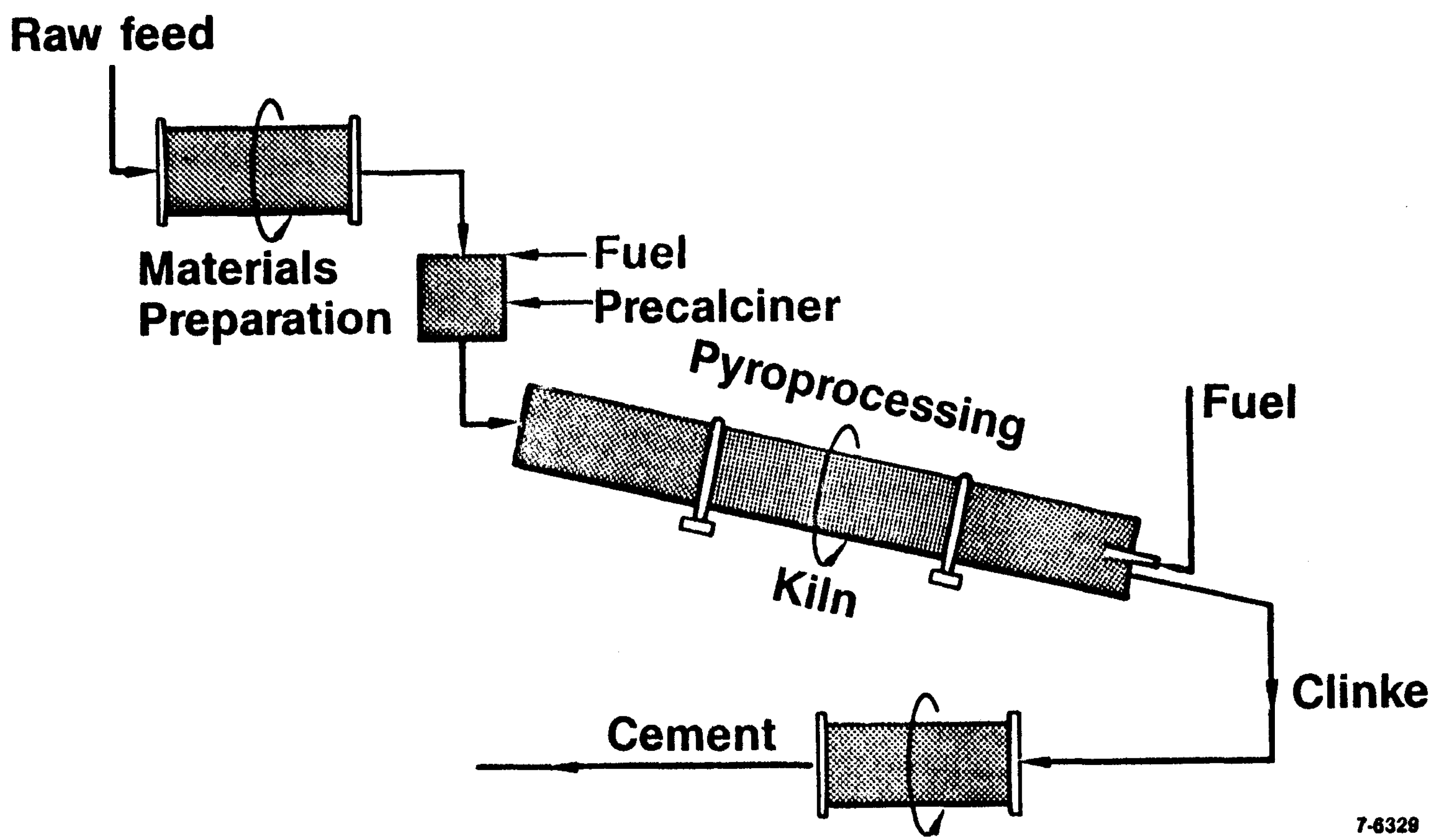

Figure 1

Standard Metropolitan Statistical Areas (SMSA's)

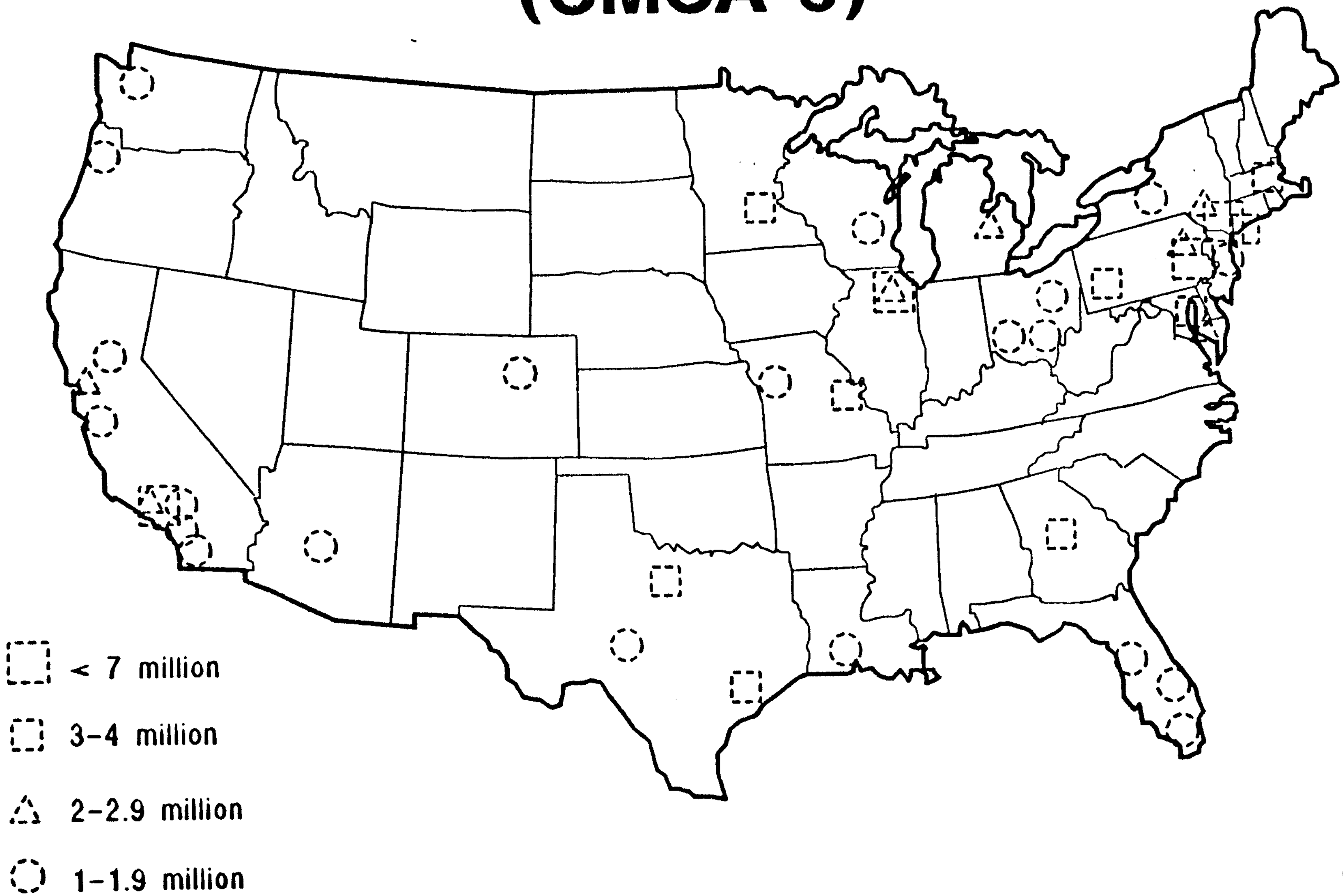

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Figure 2

Tire Stockpile Locations

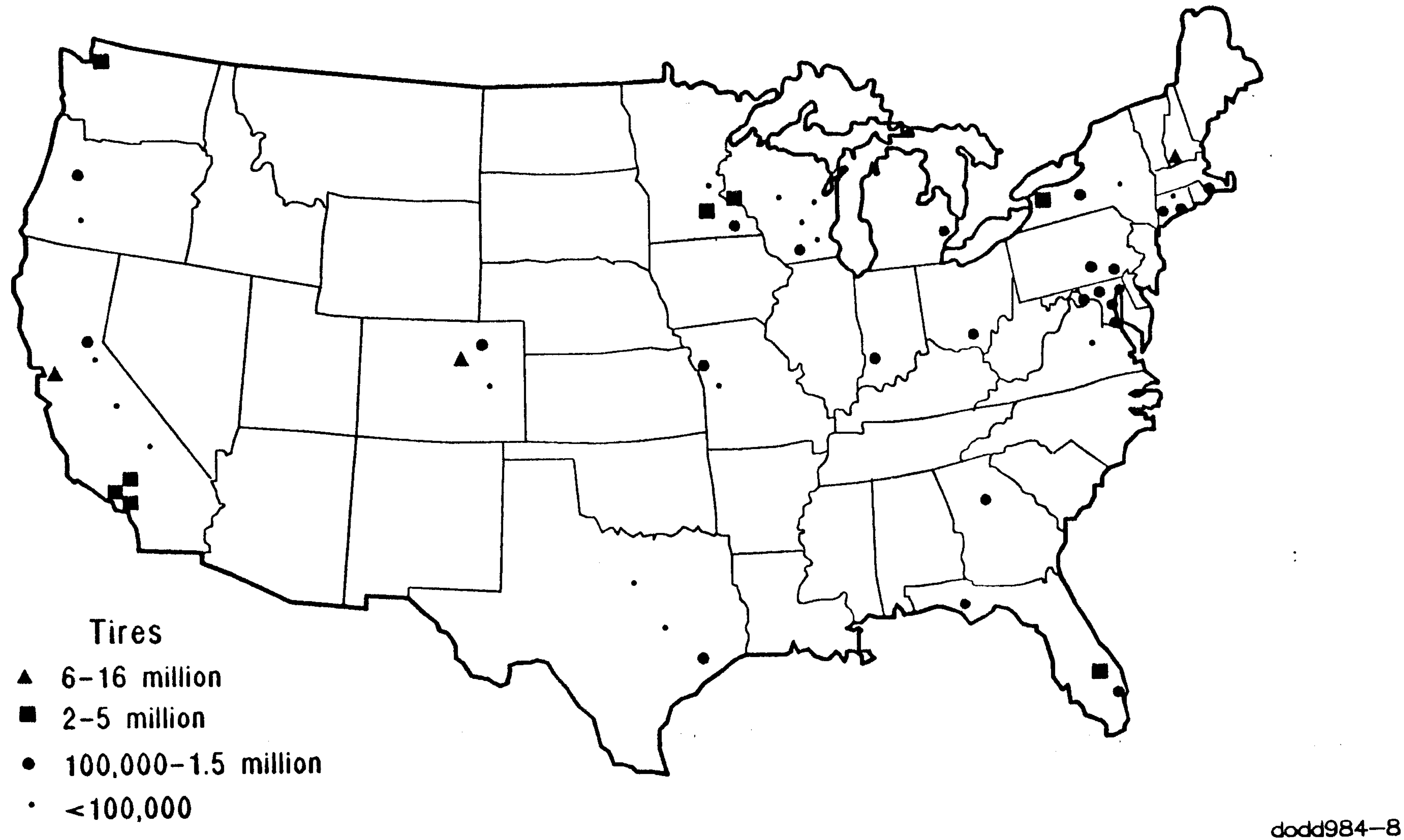

Figure 3

United States Portland Cement Plant Locations

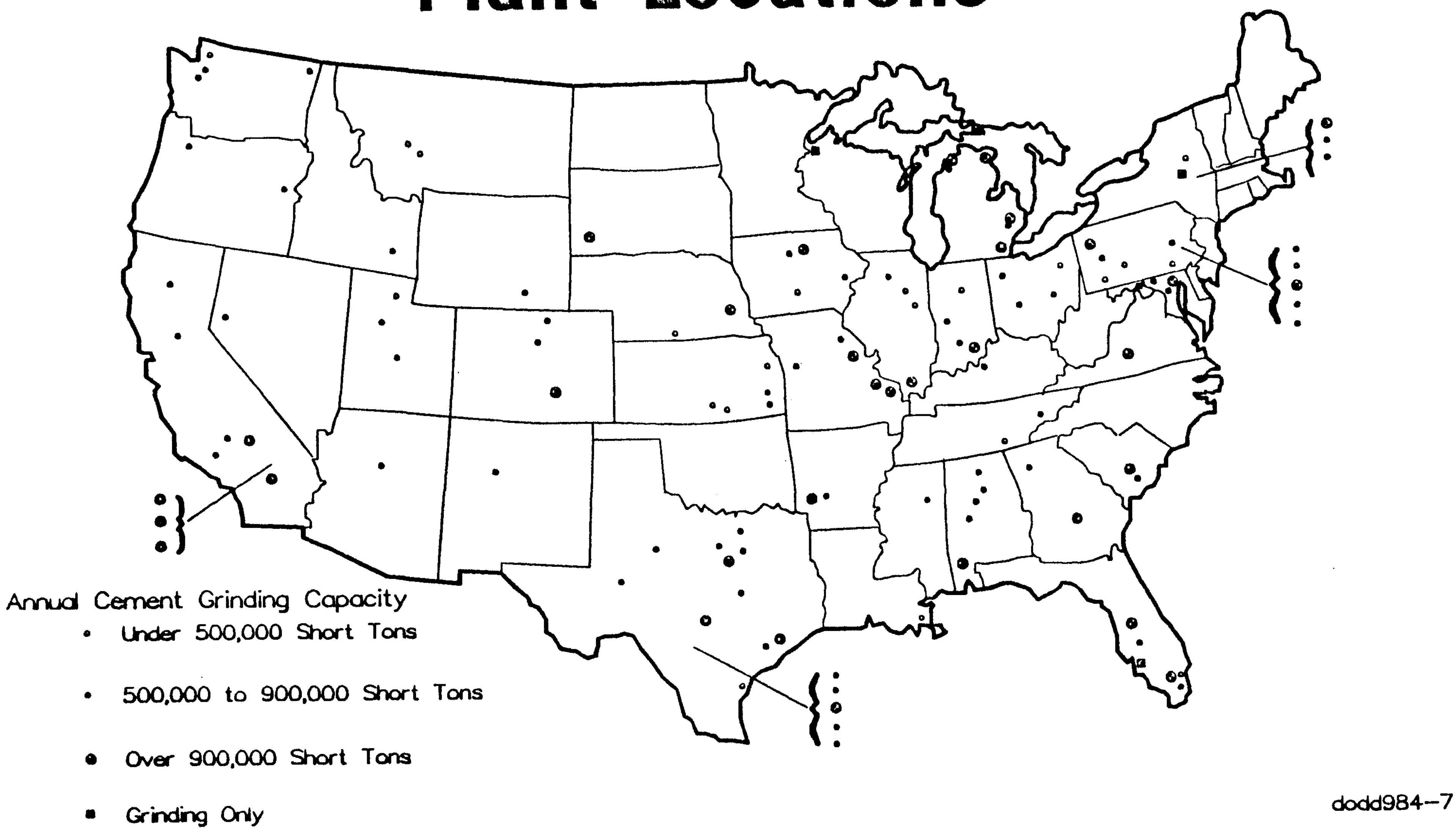

Figure 4

Tire Stockpiles/Cement Kilns/SMSA's

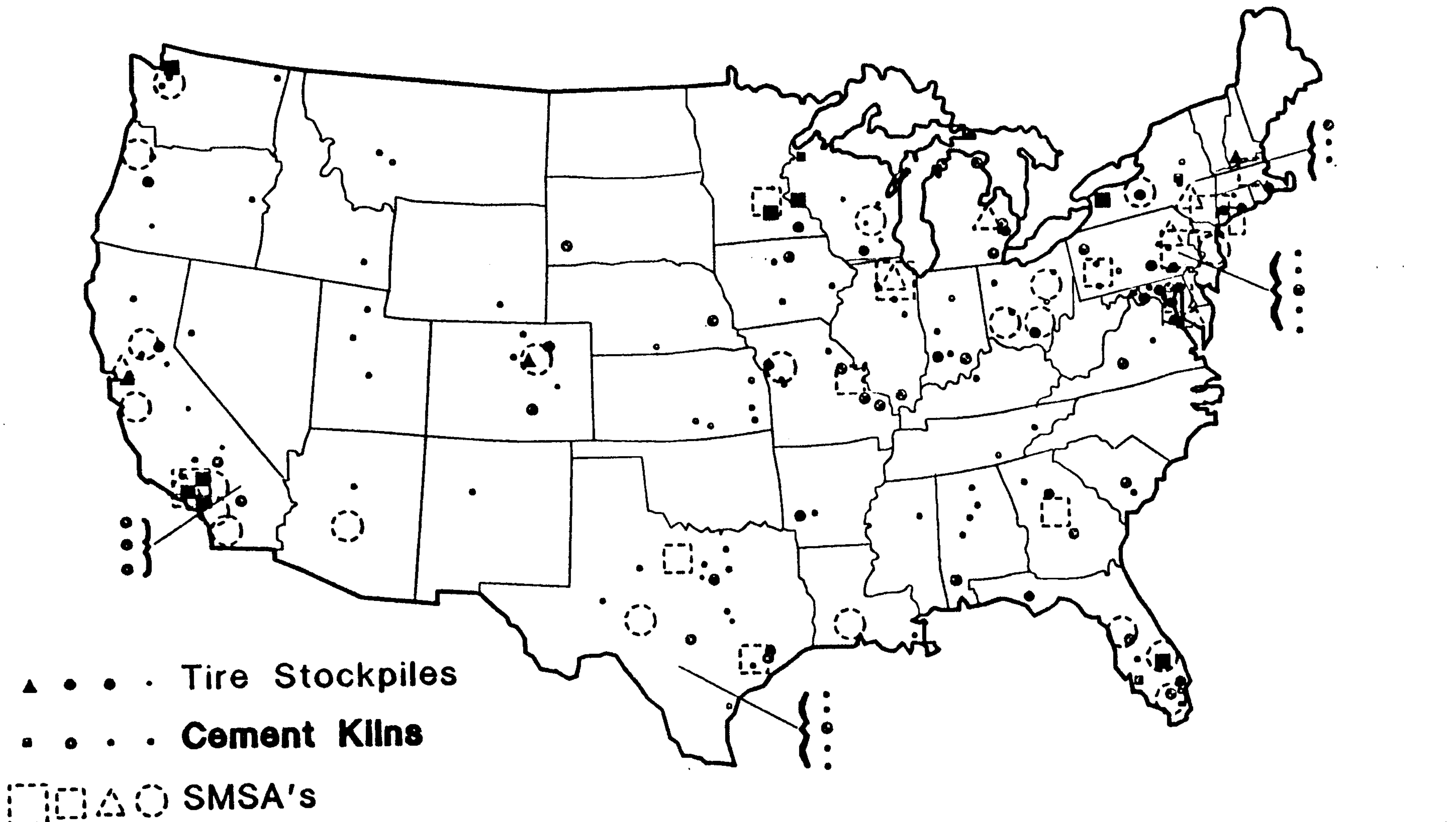

Figure 5