

ILLINOIS POLLUTION CONTROL BOARD  
October 13, 1977

IN THE MATTER OF: )  
 )  
 )  
PROPOSED AMENDMENTS TO ) R75-9, R76-8, -12, -13  
CHAPTER 2: AIR POLLUTION, ) (CONSOLIDATED)  
RULE 206: CARBON MONOXIDE )  
 )

ORDER OF THE BOARD (by Mr. Goodman):

The following are hereby adopted as a proposed final draft Opinion and Order of the Board in this matter. The proposed final draft Order shall be set for publication and a 45-day public comment period. The Proposed final draft Opinion shall be made available for public inspection during such 45-day public comment period.

PROPOSED FINAL DRAFT OPINION AND ORDER  
OF THE BOARD (by Mr. Goodman)\*

This matter originally came before the Board on a Petition for Regulatory Change filed by Amoco Chemicals Corporation on June 9, 1975. That proposal, docketed as R75-9, sought amendment of Rule 206, Carbon Monoxide, of Chapter 2: Air Pollution, of the Board's Rules and Regulations. Ill. PCB Regs., Ch. 2, Rule 206. The petition's purpose was to avoid the enforcement of existing carbon monoxide standards in Rule 206(c) (petroleum and petrochemical processes) against emissions from operations at the Amoco Joliet plant. See, Amoco Petition, ¶2; R.62.

After the first hearing in the matter, three additional parties (Stepan Chemical, Koppers Co., Reichhold Chemical) also filed Regulatory Petitions, as set forth below. The common cause among the four petitioners is a specific chemical process, also described below, and a contention that such processes should not be regulated under standards applicable to, or designed for, petroleum and petrochemical processes.

\*The Board wishes to thank Vincent P. Flood, Jr., Attorney, Hearing Officer in this matter, for his assistance in the preparation and drafting of this Opinion and Order.

THE PETITIONS

Amoco's original proposal would have added a new subsection (h) to Rule 206, specifically governing Amoco's "Organic Chemical Partial Oxidation Processes." Although AMOCO's proposed regulatory change did not include a definition of "Organic Chemical Partial Oxidation Processes," Amoco did submit a proposed definition, after the first hearing in this matter, to be added to Rule 201 of Chapter 2. The definition delineated more clearly the areas which Amoco hoped to encompass in its original proposal by listing 24 specific, individual processes, or groups of processes, and generally including, "any oxidation process which yields primary products intermediate between the starting organic material and the oxides of carbon."

Shortly after AMOCO's proposed definition was received, the Stepan Chemical Co. filed a Regulatory Petition of its own (R76-8), asking that it be consolidated for hearings with Amoco's proposal. The Stepan proposal did not (like Amoco's) ask that a separate sub-part of Rule 206 be added; instead, Stepan asked that the processes involved be regulated by exception from "petroleum and petrochemical process" in a new subsection 206(c)(4).

At approximately the same time, Koppers Co., Inc., also filed a Regulatory Proposal, R76-12, also asking that it be consolidated. Koppers also wished to add a new subsection 206(c)(4).

Shortly after Reichhold filed the fourth Proposal (R76-13) seeking enactment of a new Rule 206(h) (Organic Chemical Partial Oxidation Processes), it filed an amendment to that Proposal, withdrawing the original R76-13, and asking Board enactment of the following:\*

"Rule 206(h): Polybasic Organic Acid Manufacturing Process.  
No person shall cause or allow the emission of any gases containing carbon monoxide into the atmosphere from any polybasic organic acid manufacturing process unless the total fuel value of the waste gas stream is less than 30% of that required for flame incineration of the waste gas stream at 1460°F, without heat exchange, and the source does not cause a violation of the National Ambient Air Quality Standards, a source may use approved dispersive techniques. Polybasic acid manufacturing processes not meeting the above conditions shall burn such waste gas stream in a direct flame afterburner so that the resulting

\*As noted below, p.16, the proponents generally concurred in Reichhold's Amended Proposal after the close of the hearings. It is therefore the only proposal reproduced fully here.

concentration of carbon monoxide in such waste gas stream is less than or equal to 200 ppm or such waste gas stream is controlled by other equivalent air pollution control equipment approved by the Agency according to the provisions of Part 1 of this Chapter."

With its second proposal, Reichhold also asked for a new definition in Rule 201 to accompany the proposed Rule 206(h):

"Polybasic Organic Acid Manufacturing Process: Any process involving partial oxidation of hydrocarbon with air to manufacture polybasic acids or their anhydrides, such as maleic anhydride, phthalic anhydride, terephthalic acid, isophthalic acid, trimellitic anhydride. A polybasic manufacturing process is not a petroleum or petrochemical process."

A final proposal, called "unofficial" by the Agency, was made by Reichhold in its briefs. Reichhold suggested that the Board take the option of simply not regulating "partial oxidation processes," in either of two ways: (1) The Board could define "Petrochemical Processes" to exclude the various petitioners' processes; or, (2) it could simply declare that the petitioners' "partial oxidation processes" are not governed by Rule 206(c).

#### THE PROCEEDINGS

The Board originally authorized hearings on the Amoco proposal, R75-9, at its meeting of July 31, 1975; the proposal was published in Environmental Register #107, dated August 5, 1975, (Ex. 2). After additional publication, and public notice pursuant to the Board's Procedural Rules, a hearing was held in Joliet on the Amoco proposal on February 24, 1976. That hearing was concerned almost entirely with the operations and emissions associated with the Amoco Joliet plant.

The Stepan proposal was filed on March 22, 1976, and authorized for hearing and publication on April 8, 1976. At that hearing, the Board also entered an Interim Order allowing Stepan's Motion for Consolidation. R76-8 was published in Environmental Register #123.

Additional Interim Orders were entered on May 6, 1976, and June 18, 1976, granting similar motions by the Koppers Company (R76-12) and Reichhold Chemicals (R76-13). Those proposals, as set out above, were published in Environmental Registers #125 and #128, respectively.

Further hearings on the merits of the various proposals were then held on July 12 and 13, 1976, and March 7, 1977 in Chicago. The Hearing Officer also granted motions to include in the record in this matter the voluminous records generated in prior adjudicative cases. Reichhold Chemicals v. EPA, PCB 73-539, 74-111 (Consolidated); Stepan Chemical Company v. EPA, PCB 74-425, 17 PCB 105 (1975). The records in those cases were given exhibit Nos. 31 and 32, respectively. Additional evidence on the merits was also entered, principally by Koppers, at the second of two Economic Impact hearings, held March 21, 1977.

An Economic Impact Study, as required under P.A. 79-790, was filed by the Institute for Environmental Quality on December 22, 1976, (IIEQ Doc. #76-28; Ex. E-1). Hearings on that study were held March 7 and 21, 1977, in Chicago and Springfield.

Additional Interim Orders, related to briefing schedules, were entered on May 12 and 26, 1977. There is still outstanding a Motion, filed by the Agency on May 5, 1977, asking that final decision in this matter be deferred for a period of one year, to allow the proponents to gather additional Ambient Air Quality data.

#### THE PROCESSES

The various proposals generally describe processes which the proponents wished to regulate separately. While specifics in those proposals may have differed, the proposals generally were aimed at processes using catalytic reactions to partially oxidized organic feedstocks, usually (but not necessarily) derived from petroleum or another petroleum derivative (R.46-50).

Data accompanying Amoco's proposal, R75-9, described its process as follows:

"Amoco's primary Mid-Century oxidation process uses acetic acid solvents with a bromine promoter and cobalt manganese catalyst to oxidize xylenes to dibasic acids...Preheated acetic acid, para-xylene and catalysts, together with high-pressure air are charged to an agitated reactor operating at moderate temperature and pressure, 400°-450°F and 330-400 psig.

The production of isophthalic acid (IPA) and trimellitic anhydride (TMA) at separate units are similar except for the feedstock. Meta-xylene and pseudocumene are used in place of para-xylene.

Amoco's first witness described the process as "doing a very simple replacement," (R.20). When air is bubbled through the agitated liquid reactor, four hydrogen atoms are stripped from the para-xylene feedstock, "hoping to replace all four of them with oxygen atoms, while at the same time neither oxidizing any of the carbons or remaining hydrogens in the molecule." (*id.*) Unsuccessful reactions result from shearing the benzene ring or by succeeding in attaching less than the optimum four oxygens, and the by-products must then be removed prior to sale. The resulting chemical intermediate is used in making polyester film and fiber (R.18). See, Ex. 7.

Amoco's Joliet plant produces approximately 4% of all U.S. crude terephthalic acid; Amoco has 25-30% of the national market if its out-of-state plants are considered, (R.131; See, materials accompanying Amoco's petition, R75-9). Amoco's Joliet plant presently produces 100% of the world's trimelletic production and 100% of the isophthalic acid market in the United States, (R.131-32). In the latter two cases, however, other products such as phthalic anhydride can be substituted directly, (R.133; but see, Ex. E-1, pp. 25, 28, 34).

Stepan's facility is, like Amoco's, located along the Des Plaines River near Joliet, 1.2 miles from Amoco, (R.12). The operation of the Stepan plant (the Millsdale plant) was described in a previous Board opinion in PCB 74-425, supra, a variance proceeding. Stepan uses an ortho-xylene feedstock reacted to produce phthalic anhydride. 17 PCB 105, 106 (1975). A solid, white crystal at room temperature, phthalic anhydride is used as a plasticizer to make polyester resins and in the paint industry. The process involves passing heated air and vaporized ortho-xylene over a solid catalyst for oxidation to phthalic anhydride. The impurities in the process include phthalic anhydride, benzoic acid (See, Ex. 32, record at 9 in PCB 74-425.) The principal emissions from the Millsdale plant are phthalic anhydride and carbon monoxide, (*id.* at 11), with an off-gas temperature of 140°F and 1/2% CO, (*id.* at 13).

Koppers also produces phthalic anhydride, at a plant in Stickney, Illinois, (R.255, Ex. 36). Using steam, process air is preheated. The ortho-xylene raw material is injected into the heated air stream and enters a fixed-bed catalytic reactor where an exothermic, partial oxidation reaction takes place, (R.260). Heat is withdrawn from the reaction indirectly via salt baths, and used for steam generation. "The vapor phase continues to a gas cooler...and on to the switch condensers where the crude phthalic anhydride is solidified and removed from the gas stream. The crude

phthalic anhydride is then melted from the switch condensers in cycles, sent on to pre-decomposers, the stripper column, and steam column, where it is refined to produce a marketable product. The reaction gases pass from the switch condenser to the aqueous scrubber where they are scrubbed and then exhausted." (R.261). The Stickney facility uses six reactors, which share various downstream equipment such as switch condensers and scrubbers. There are four emission sources (stacks), (R.262).

The Reichhold plant is located adjacent to the Illinois River about six miles from Morris, Illinois, about fifteen miles from Joliet, and forty-seven to fifty air miles from downtown Chicago, (Ex. 31, Transcripts, Vol. 2 at p.67). The Reichhold plant produces maleic anhydride using air and benzene, with a catalyst, in a reactor at specific temperatures. The off-gases are cooled prior to entry into primary recovery units (switch condensers). Additional maleic anhydride is recovered in the successive water and caustic scrubbers, the caustic scrubber converting any remaining maleic anhydride to sodium malate, which is then incinerated. The gas stream is also passed through carbon absorbers to recover unreacted benzene. Reichhold testified that carbon monoxide is an unavoidable by-product of the exothermic reaction involved in maleic anhydride production, (*id.*, at 75-76; See, Ex. 32, 33 in PCB 73-539, 74-111 [consolidated] Ex. 31 in this matter).

It can be seen that these four companies use essentially the same processes, with slight variations, using similar organic feedstocks.

There was some discussion as to whether any firms or chemical processes other than the proponents might be covered under any of the proposals, (R.667; Ex. 71). The Agency did supply a list of those who would potentially be effected by a specific regulation for partial oxidation processes. That list, however, was compiled for the 1964-1966 period, (see, Public Comment #12). The list indicated several producers besides petitioners in this case which might conceivably fall within the definitions offered by the parties for partial oxidation processes; these included Witco Chemical Company (Chicago), the Sherwin-Williams Company (Chicago), Clark Oil Company (Chicago) and Gulf Oil (Calumet City). Each of those additional potentially effected producers was, according to the Agency's list, engaged in processes which would have been included within Amoco's list of affected processes proposed as an appendix to Rule 201, (see page 2 *supra*). As noted in the record, however, (R.667), that list is probably obsolete. The Institute's contractor found that there are, at present, only four chemical firms that use partial oxidation processes in the manufacture of their products: the four proponents here, (Ex. E-1 at 2, 26, 29-33, Tables 6-9).

The best evidence before the Board, then, is that the only four firms potentially effected in this matter are those before us here. We therefore limit our analysis to their emissions and the effects of such emissions.

#### EMISSIONS

Amoco's emissions are described in various places throughout the record. The existing units at the Joliet Plant discharge from 7,583 SCFM to 10,833 SCFM per hour (36,416 to 51,620 lb/hr). Of those discharges, nitrogen constitutes from 92-95% of the total. Carbon monoxide, on the other hand, ranges from 0.1% to 1.2% (Ex. 9; see also Ex. 19, Table I). Amoco's permit application for the Joliet Plant showed a total discharge of 834 lb/hr of CO, (Ex. 8). Agency calculations, on the other hand, show a total discharge by Amoco of 700 lb/hr, or 1,980 tons/yr, (Agency Brief at 3). The exhaust gases from the Amoco Plant are discharged at approximately 100°F, (e.g. R.98).

Stepan's process results in discharges of 192,000 pounds of air and about 1,000 pounds of carbon monoxide per hour, with trace amounts of organic chemicals and 3400 lb/hr of carbon dioxide, (Ex. 32, PCB 74-425, Record at 11). The discharge is 1/2% CO, at an exit temperature of 140°F, (id. at 14). Agency calculations indicate Stepan's discharges at 980 lb/hr, or 3,460 tons/yr.

Koppers discharges are somewhat greater for all components, but similar in relative composition. A total of 4,400 lb/hr of CO is discharged, at a concentration of 3,700 ppm in a waste stream composed largely of nitrogen (750,000 ppm), oxygen (160,000 ppm) and water (65,000-86,000 ppm). (See, e.g., Ex. 42). The Agency's calculations for Koppers were 3,970 lb/hr of CO, or 15,670 tons/yr.

Carbon monoxide is also an unavoidable by-product of the manufacture maleic anhydride at the Reichhold plants, (Ex. 31, Record in PCB 73-539, 74-111, at 75). The off gases from the maleic manufacturing processes include 1.7% carbon monoxide, 16% oxygen, with the remainder largely nitrogen, (e.g., id., Volume II at 101; see also, id. at Ex. 10: 3,360 lb/hr). The Agency estimated Reichhold's discharges as 10,000 tons/yr.

In summary, although the CO emissions vary from Petitioner to Petitioner, it can be seen that the makeup of the Petitioners' total emissions is quite similar from Petitioner to Petitioner. The Agency's estimate of total CO emissions for all four Petitioners is 31,050 tons/yr.

AMBIENT AIR QUALITY

All four of the Petitioners in this matter are located generally near Chicago. Although there were no 1976 violations of the 35 ppm one-hour ambient air quality standard in the Metropolitan Chicago Interstate Air Quality Control Region (No. 67), there were violations of the 9 ppm eight-hour ambient air quality standards. Five different sites in the region (containing all of the Petitioners) recorded excursions above 9 ppm; all of those violations took place within the city of Chicago. See, Illinois Environmental Protection Agency, 1976 Annual Air Quality Report, at 78, 91. (We shall, for purposes of this analysis, take notice of the Agency's 1975 and 1976 Annual Air Quality Reports). One of those five sites recording excursions had only one reading in excess of 9 ppm, which is allowed under the ambient standard, Rule 310(a)(1). The remaining four sites had, total, twenty-two instances where the ambient air quality was standard, sixteen of those being concentrated at the CAMP Station in downtown Chicago, (id. at 91).

These figures are considerably better than those recorded in 1975. In that year, there were both more sites registering violations, including Joliet with two excursions above 9 ppm, and a greater number of violations (although most of the decrease resulted from improved readings at the CAMP and Cermak Stations in Chicago). See, 1975 Annual Air Quality Report at 40, 82, Table 12.

Testimony by Dr. Babcock in 1975, in the Reichhold variance case, indicated total CO emissions in the region of approximately 3,000,000 tons/yr. (PCB 73-539, 74-111 (Consolidated) Vol. II, at 23.) At that time, estimating Reichhold CO emissions of 15,000 tons/yr, Dr. Babcock found that Reichhold's emissions constituted roughly four tenths of 1% of those in the region. (id. at 24). Using instead the Agency's estimates for all four Petitioners in this matter amounting to 31,050 tons/yr, we see that the contribution of all four sources to the total CO in the region is approximately 1% or less. \*

In addition to the general information on carbon monoxide available for the region containing the Petitioner's plants, each of the Petitioners has individually submitted both modeling and monitoring results. Such data was first submitted to the Board in the Stepan variance, PCB 74-425, supra. Although the placement

\*Dr. Babcock testified that the principal contribution to ambient CO is by the automobile, which leads to existing air quality violations in areas of heavy auto traffic. The Agency's Annual Air Quality Reports for 1975 and 1976 agree, stating that, "the major source...by far is the motor vehicle." 1976 Annual Air Quality Report at 10. Dr. Babcock estimated that motor vehicles account for over 2/3 of the total, in excess of 2 million tons/yr. 73-539, 74-111 (Consolidated), Record, Vol. II at 23.



of the monitors in that initial study seems somewhat arbitrary, (PCB 74-425, Record at 5), and readings were taken for only the month of August, 1974, (id. at 59), Stepan's monitoring contractor reached the opinion, "that there is no significant impact from the emissions from [Stepan]." (id. at 61). (Although there was one eight-hour violation, at 11 ppm, the wind direction precluded any Stepan contributions; that excursion was attributed to "automotive exhaust or some other form." (id. at 62). Most readings were on the order of 2 ppm, (id. at Ex. 11, 12; but see, id. at R.67).

Again utilizing Dr. Babcock, Stepan presented evidence to show that its emissions (assuming 4500 tons/yr CO) amount to approximately 0.1% of the CO in the air quality control region. Dr. Babcock testified that Stepan's emissions would not have any effect whatsoever on violations in downtown Chicago, and would be unlikely to have any effect on excessive concentrations elsewhere in the region, due to its remoteness from concentrations of automobiles, (id. at 85). Stepan's final exhibit in that proceeding, (id., Ex. 14), was a study showing the general effect of a change to Rule 206(c), finding that the effect on CO ambient air quality would be negligible, even if applicable to such major emitters as refinery.

Reichhold's ambient air quality data was also submitted in a prior adjudicative case, PCB 73-359, 74-111 (Consolidated), supra. Testimony there indicated that a violation of the ambient air quality as a result of Reichhold's operations was possible, but only under extremely adverse meteorological conditions, including a combination of low wind speeds, unstable conditions and the presence of a very low level inversion; even under such conditions, violations could take place only within a radius of 300 meters from the stack, with concentrations decreasing rapidly both closer to and farther from the emission source, (73-539, 74-111, Record at 10-14; but see, id. at 18, 19). Using Agency figures and Reichhold modeling, it was estimated that Reichhold might contribute 0.4% to the total ambient CO in the Metropolitan Chicago air quality control region. Again, the contribution was termed "negligible." (id. at 25).

Reichhold did not monitor at its plant. Instead, Reichhold submitted the results of the study prepared for Commonwealth Edison at Collins Station, approximately one mile from the Reichhold plant, (id. at 117). Reichhold also noted that a study was made at the Amoco Joliet plant, about six miles from Reichhold's facility, (id.). Although the monitors in the Edison study were obviously not placed to record contributions by Reichhold, the use of wind data made possible some analysis of the effect of its emissions, (see, id. at 122). Although the monitoring period was short (again, one month), the results of the study do show that CO is not generally a problem in the vicinity of the Reichhold plant, (id. at 126).

Amoco's modeling and monitoring results were submitted at the first hearing in this matter. The highest one-hour value for CO recorded was 5.9 ppm; the highest eight-hour value was 4.28 ppm, (R.88). The data gathered during Amoco's monitoring program correlated generally with dispersion modeling, which did not indicate potential violations, (R.92; Ex. 15). Like the monitoring studies undertaken by Stepan and Reichhold, however, the Amoco program was conducted for a limited time: March and April, 1974, (R.84). Additional information was submitted by Amoco at the July 12, 1976 hearing, (see, e.g., R.213, Ex. 34). Again, a violation was not indicated.

Koppers is located closer to those downtown Chicago areas which have experienced ambient air quality violations for CO, although its Stickney plant is still considerably removed from any of the monitors which have indicated violations. As with the other companies, Koppers presented testimony and evidence that would support its contention that its CO emissions could not either have caused violations in the neighborhood of its own plant, or have contributed to the existing violations farther away. Although there were some anomalies in the test results, (e.g. R.509-511), and the monitoring locations may not have been perfectly chosen, (R.405), Koppers' modeling generally showed that its emissions did not cause CO ambient air quality violations, (e.g., R.436).

Finally, some additional data with regard to the Stepan monitoring, corroborative of the data received in PCB 74-425, was introduced by Stepan for cross-examination purposes, (R.534).

#### CONTROL TECHNIQUES

It was the general contention of all of the Petitioners in this matter that the carbon monoxide emissions from their plants, as detailed above, simply cannot be controlled to the levels required by Rule 206(c) in an economically reasonable manner. Most of the testimony and evidence presented by the parties in this matter, as well as the preponderance of that seen in the earlier adjudicative cases, concerned the costs and technical difficulties associated with the control of CO emissions from partial oxidation processes. The Board has been aware of these issues for some time; as the Agency points out, the issues here have been presented more or less continuously since 1973. See, e.g., PCB 73-365, PCB 74-63, PCB 74-325, PCB 75-350 (Koppers); PCB 73-539, 74-111 (Consolidated), supra (Reichhold); PCB 73-460, 74-425, 76-161 (Stepan).

The proponents concentrated on four methods for the removal of carbon monoxide from their emissions.

- (1) Incineration; at approximately 1500°F., carbon monoxide is effectively oxidized and eliminated. This method, for these Petitioners, requires considerable fuel input inasmuch as the off-gases are at a very low temperature with little fuel value, (as described above for each Petitioner).
- (2) Incineration with heat recovery; under this method, both conventional and innovative heat recovery techniques are employed to cut fuel requirements.
- (3) Cold catalytic oxidation; the Board discussed this method previously in variance matters, supra, while research was being funded. The programs have been dropped because -- despite some laboratory successes -- the method has not proven feasible.
- (4) Thermal catalytic oxidation; this method, while not requiring the quantity of fuel necessary for incineration, does require some energy input for successful CO removal. This method, discussed chiefly in terms of a Du Pont proprietary system, is also useful for removing other contaminants such as hydrocarbons. It was covered extensively by the parties and in cross-examination by the Agency. There was even some discussion of recovering heat from the exothermic partial oxidation process itself in conjunction with this method.

The parties also discussed briefly the additional possibility of using exhaust gases from the partial oxidation processes as combustion air for other requirements at the Petitioners' facilities, such as steam boilers. Because of the quantity of exhaust gases involved, however, this method was shown to be impractical.

Incineration. There can be no question of the fact that incineration does constitute a technically practical method for the elimination of carbon monoxide from the Petitioners waste gas streams. Although the parties presented arguably valid evidence to the effect that combustion by-products of incineration (e.g., SO<sub>2</sub>) would constitute worse pollution problems than uncontrolled CO, and to show the unavailability of fuel for such incineration, their principal contention with regard to incineration as well as the other potential control technologies was one of simple cost-benefit.

They argue that the relatively small amounts of CO removed cannot justify the enormous capital and operating costs involved.

In its most recent variance case, PCB 76-161, Stepan estimated that the incineration of its emissions would require, in addition to any capital costs, 4,000,000 gallons of fuel oil per year, (PCB 76-161, Record at 23). That figure is quite compatible with the evidence received in this matter. Koppers, for example, estimated that even with heat exchange at a maximum of 57%, 961 gallons of fuel would be required each hour, or a total of 7,611,000 gallons per year, (Ex. 50). Amoco estimated that incineration would require 2,000,000 gallons per year of No. 6 fuel oil, (Ex. 20). As early as 1971, Reichhold had estimated that its 1.7% carbon monoxide waste gas would require .075 MBTU's for every 1,000 lbs. of exhaust gas to achieve incineration, or 45,000,000 BTUs per hour. Even if natural gas were available at that time (1971), the necessary natural gas would have cost \$250-300,000 per year, with a capital cost for the incinerator of \$300,000-400,000, (PCB 73-539, 74-111 (Consolidated) Ex. 36, at 2). Gas is now unavailable for such purposes, of course, and prices for fuel and construction have risen.

Heat Recovery. In addition to normal heat recovery systems, Koppers investigated a "Reeco" system utilizing extremely high heat exchange (85-90%). The units involved would cost \$5,000,000, with operating costs in the basis of \$400,000-600,000 per year, (R.314). Such units have not been widely tested.

Cold Catalytic Oxidation. Koppers also investigated various cold catalytic oxidation control systems, going so far as to solicit bids from vendors, (R.280-301). Pilot plants were actually installed, (Ex. 53). In general, due to catalyst blinding, systems upsets and unsatisfactory emissions, the systems have been very unsatisfactory.

Thermal Catalytic Oxidation. Stepan has done considerable work with the Du Pont Catalytic Reactor System. This system operates by heating the off gases and passing them over a catalyst; hydrocarbons are oxidized to carbon dioxide and water while carbon monoxide is oxidized to carbon dioxide. In addition, it appears that heat exchange may significantly reduce the need for supplemental fuel for the system's operation. In its most recent variance request, Stepan proposed the installation of such a unit, for the control of hydrocarbon emissions as well as carbon monoxide; reductions in plant discharges have been estimated at 85-95% for organics and 96-100% for carbon monoxide in pilot plant testing.

Whether the Du Pont system would be applicable to the other proponents, however, is unclear. Amoco, Koppers, and Reichhold utilize other methods for hydrocarbon control, increasing the relative cost of such a system for CO control.

Again, in summary, control of CO emissions from partial oxidation processes is technically practical. Given sufficient fuel for incineration, or sufficient capital investment for catalytic reaction, each of the Petitioners could readily comply with the 200 ppm CO standard in Rule 206(c). The issue, simply, is cost.

#### ECONOMIC IMPACT

The Institute's Economic Impact Study, IIEQ Document No. 76-28, concludes that, "although thermal incineration is technically and economically feasible...this method would be inefficient because incremental social benefits appear to be significantly less than incremental social costs. Even though the social costs of thermal catalytic oxidation would be less, we still conclude that compliance with Rule 206(c) is inefficient using the least-cost method, since these firms contend that they meet Federal standards for CO emissions.

"In the long run, if all four firms complied with Rule 206(c), the loss of social benefits from plant relocations and the impact on energy would make compliance with Rule 206(c) inefficient." (Ex. E-1 at xvi).

Section 6(b) Coverage. Sec. 6(b) of the Act requires that the Institute's studies consider a wide range of specific environmental and economic effects which might be associated with proposed regulations, as well as contain, "an evaluation of the environmental costs, and benefits of the rules and regulations to the People of the State of Illinois, including the health, welfare and social costs and benefits." Ill.Rev.Stat.,Ch.111 1/2, §1006(b)(1) (1977). The study in this matter considered all of the various sectors set forth there, under the same short-run/long-run basis noted in the conclusion quoted above. See, e.g. Ex. E-1 at Table 1, ch. V. The study's investigation of economic effects, based on comparisons between enforcement of the present regulation and the effective de-regulation proposed by the parties, was adequate and generally supportive of those quoted conclusions.

The macro-economic effects described in the study (indicating excessive cost and little benefit resulting from enforcement of Rule 206(c) as it exist) result principally from macro-economic effects upon the four firms constituting the organic chemical partial oxidation industry in Illinois. The study found that although -- in

the short term -- enforcement of Rule 206(c) would impact negatively only upon the four producers, short and long terms effects upon those producers would negatively impact the economy of Illinois generally. As "price takers", with fragile market shares, Illinois producers are unable to raise prices by amounts necessary to offset the costs which would be associated with Rule 206(c) compliance. See, e.g., Ex. E-1 at 32. As a result, the study found that Illinois producers would, in the indeterminate "long run", be forced to relocate elsewhere, with significant, general, negative impact for Illinois.

The study performed in-depth analysis of the cost of compliance upon each of the companies. Although there were some corrections of the figures used by the Institute at the hearings, the data nonetheless indicated that the enforcement of Rule 206(c) limitations for CO against the four firms would result in cost increases which could not be offset by price increases, (id., Ch. IV, §§B-D),

The only significant dispute regarding the economic study was the Agency's contentions that, (1) the study was in error when it found that the benefits of enforcement could not be properly computed, (e.g., Ex. E-1 at 69-74); (2) the study was in error when it assumed, for benefit measurement, that none of the four impacted firms would cause or contribute to a violation of ambient air quality standards, based on a lack of adequate data. We find that these issues are properly resolved using, for benefit analysis, our ambient air quality standards for carbon monoxide; we shall discuss below the adequacy of the data before us.

#### ISSUES

Although the adequacy of the record on the question of ambient air quality compliance is unquestionably the major issue which we must decide, there are several issues which the parties raised throughout this proceeding.

- (1) In both the prior Stepan and Reichhold variances as well as this regulatory proceeding, the parties argued at length that it was never the Board's intention that organic chemical partial oxidation processes be regulated by Rule 206(c).
- (2) Are the Petitioners' processes "petroleum or petrochemical" processes? The parties argued that regardless of what might have been the Board's original intent, their processes are not petroleum or petrochemical processes, and should not be subject to the same standards as, e.g., refineries.

- (3) Is it technically practicable for the Petitioners, or their processes, to meet the 200 ppm standard of Rule 206(c)? Although, as we noted above, thermal incineration is an effective control method for carbon monoxide, there are nonetheless problems with enforcing the regulation. Principally, the parties argued that it is irrational to apply a "50% excess air" criteria to their processes, inasmuch as excess air limitations are generally used to prevent the dilution of waste gas streams. The parties discussed this question at length in the prior variance hearings, and at the hearings on these regulatory proposals, (e.g. R.36-40).
- (4) Is it economically reasonable to require that the proponents here comply with any carbon monoxide standard?

Since we decide that the ambient air quality data is adequate, and does support proponents' position, and that the enforcement of Rule 206(c) or some other standard against the proponents would be economically unreasonable, we specifically decline to answer any of the other issues raised.

Whether the Petitioners' processes were considered by the Board in the enactment of Rule 206, or whether they are "petrochemical" processes, is immaterial, inasmuch as we choose to regulate these processes separately. We need not discuss the application of "50% excess air" to the Petitioners emissions, or the availability of new control techniques such as Du Pont's, since the ambient air quality and cost data before us justify the separate regulation of Petitioners.

The Agency contested -- rather strenuously -- the adequacy of the modeling and monitoring performed by the proponents to show that a regulatory amendment would not cause ambient air quality problems. Although there were some questions as to monitor placement in some of the monitoring situations, (see supra), the Agency did not seriously question the quality of the Petitioners' modeling or monitoring; extensive cross-examination did not uncover any serious flaw in the proponents' methodology or performance. Rather, the Agency attacked the sufficiency of the proponents' presentations in quantity terms. The Agency alleged that the Petitioners models were not calibrated, or did not include all meteorological conditions; monitoring, the Agency claimed, likewise did not cover all expected weather conditions.

The essence of the Agency's argument, and its pending motion noted above, is that more information, predictive and historical, is needed before the Board can make an informed judgment on the effect the proposed regulatory change(s). Further narrowing its argument, the Agency has not really questioned the effect of the proposed regulatory changes upon ambient air quality with regard to operations by three of the Petitioners: Amoco, Stepan and Reichhold. They are located away from Cook County in areas with few other CO sources, where there are not ambient air quality violations; the sources in question will probably not cause or contribute to violations of the one-hour or eight-hour standards. We agree with the Agency, however, that closer analysis is needed with regard to Koppers' emissions.

As noted above, Koppers is located in a suburb adjacent to Chicago, in an area where it might conceivably contribute to an ambient air quality violation. (Essentially all Illinois ambient air quality violations for CO are located in Chicago.) However, as we also noted above, Koppers is located away from problem areas within Chicago. Although it is located near some potential areas (two race track parking lots and the Stevenson Expressway), Koppers modeling and monitoring - albeit imperfect - indicate that it will not contribute to a violation.

All the proponents' data on ambient air quality, predictive and actual, is certainly imperfect. In places, it is far less than perfect. It is sufficient, however, to show that the proponents' CO emissions are highly unlikely to cause or significantly contribute to any ambient violation. There is even a possibility that control technologies would contribute to violations of other standards, e.g., SO<sub>2</sub>. Weighing that likelihood against the economic effects, micro- and macro-, separate regulatory treatment for the proponents has been justified. We shall therefore deny the Agency's motion to require additional data and defer action, and shall instead enact the regulatory change requested.

There remain, then, two final issues for decision: (1) which of the various proposals should be adopted, with what changes; and (2) should any proposal be applied prospectively to plant expansions or new plants? By the conclusion of the hearings in this matter, the proponents had generally settled upon Reichhold's amended petition, supra, as a consensus position. We agree, because that proposal limits -- in both the proposed Rule 206(h) and the accompanying definition -- the coverage of the change. We shall amend the proposed Rule 206(h), however, by deleting the references to ambient air quality, finding that proposed provision duplicative of existing Rule 102 (prohibition of air pollution). We shall also amend the proposed definition insofar as it defines in the negative with regard to



petroleum or petrochemical processes; since we are separately regulating the processes in question, it is immaterial whether they are or are not petroleum or petrochemical processes.

With regard to coverage, we feel that no specific limitations are necessary. Some of the Petitioners plants have been recently expanded, apparently without adversely effecting ambient air quality; Rules 102 and 303 will provide adequate protection with regard to new partial oxidation processes.

Finally, we note that the Agency questions its ability to obtain U.S. Environmental Protection Agency approval of a State Implementation Plan (SIP) amendment based on the existing ambient air quality data for partial oxidation processes and carbon monoxide. We feel that, in light of the relatively minor CO emissions involved (as compared to total area CO emissions, principally motor vehicle related), the fact that other states do not regulate the emissions in question, and the area's trend towards compliance, such approval should be obtainable.

The Board therefore adopts as its Proposed Final Draft Order in this matter the following.

PROPOSED FINAL DRAFT ORDER

It is the Order of the Pollution Control Board that Rule 201, (definitions) of Chapter 2: Air Pollution of this Board's Rules and Regulations be amended by addition of the following new definition:

Polybasic Organic Acid Partial Oxidation Manufacturing Processes:  
Any process involving partial oxidation of hydrocarbons with air to manufacture polybasic acids or their anhydrides, such as maleic anhydride, phthalic anhydride, terephthalic acid, isophthalic acid, trimellitic anhydride.


Rule 206, carbon monoxide emissions standards and limitations, of Chapter 2: Air Pollution of this Board's Rules and Regulations shall be amended by addition of the following sub-section (h):

- (h) Polybasic Organic Acid Manufacturing Processes. No person shall cause or allow the emission of any gases containing carbon monoxide into the atmosphere from any polybasic organic acid manufacturing process unless the total fuel value of the waste gas stream is less than 30% of that required for flame incineration of the waste gas stream at 1,460°F, without heat exchange. Polybasic acid manufacturing processes not

meeting the above conditions shall burn such waste gas stream in a direct flame afterburner to achieve a resulting concentration of carbon monoxide in such waste gas stream of less than or equal to 200 ppm, or shall employ such other, equivalent control method or equipment as may be approved by the Agency according to the provisions of Part I of this Chapter.

Mr. Werner dissents.

I, Christan L. Moffett, Clerk of the Illinois Pollution Control Board, hereby certify the above Proposed Final Draft Opinion and Order were adopted on the 13<sup>th</sup> day of October, 1977 by a vote of 4-1.

  
\_\_\_\_\_  
Christan L. Moffett, Clerk  
Illinois Pollution Control Board