REVISED ENVIRONMENTAL ASSESSMENT FOR FCN 283

1. **Date:** October 30, 2002

2. **Name of notifier:** Stockhausen, Inc.

3. **Address:** 2401 Doyle Street
   Greensboro, North Carolina 27406

4. **Description of the proposed action:**

   a. **Requested action:** Stockhausen requests that this Food Contact Notification become effective to permit the use of a grafted copolymer of cross-linked polyacrylic acid sodium salt polymer with polyvinyl alcohol (FAVOR® PAC) as an absorptive medium in absorbent pads employed in the packaging of cubed tomatoes, fresh-cut fruits and vegetables, whole berries, and fresh or frozen fish fillets. The USFDA has previously approved the use of FAVOR® PAC in the packaging of poultry (e.g. chicken) and red meat which is either refrigerated or frozen until used. *See* 21 C.F.R. 177.1211 and FCN #42.

   b. **Need for action:** Food products sold in grocery stores, supermarkets and similar stores are usually displayed and sold in packages. The package is most often composed of a supporting tray that is overwrapped by a transparent plastic film, or by a transparent plastic bag. These packages allow the consumer to inspect the product and, at the same time, protect the food from external contamination.

   Some food types, such as meat, poultry, fresh-cut fruit and vegetables, and fish, are typically washed before packaging. Fluids from washing, as well as fluids discharged from the food products themselves, can accumulate inside the package. As much as 3 ounces of fluid can accumulate in the package from the time the food is packaged until it is consumed. The accumulated fluids can support the rapid growth of microorganisms which could cause food to spoil. Moreover, fluid within the food packages often creates an unsightly appearance and may lower the product's appeal to the consumer.

   Cellulose pads are typically used to absorb excess fluid in meat, poultry, fruit, vegetable, and fish packages, but their absorption capacity is very limited. To improve absorption capacity, and specifically the retention capacity of liquid under an external pressure, an absorbent core made of special polymers, the so-called "superabsorbents," can be added to the pads. Due to their structure, these polymers have the ability to absorb excess liquid into the polymer matrix by swelling, even against external pressure.

The retention capability of the polymer prevents the squeezing out of liquid and minimizes food contamination by stagnant liquids. Thus, FAVOR® PAC is intended to be used as an absorbent agent to improve the absorption capacity, and specifically the retention capacity, of composite structures for food packaging applications.

c. **Location of use:** The superabsorbent polymer (SAP) will be used to manufacture absorbent pads in plants that manufacture food packaging or components of food packaging. The absorbent pads will be employed in the packaging of cubed tomatoes, fresh-cut fruit and vegetables, fresh whole berries, and fresh or frozen fish fillets in food processing and packaging facilities.

d. **Location of disposal:** Disposal of absorbent pads containing the SAP is expected to occur nationwide with the SAP ultimately being disposed in municipal solid waste landfills or burned as a result of the disposal of the absorbent pads.

5. Identification of substances that are the subject of the proposed action:

Generic information regarding the chemical identity of FAVOR® PAC is provided below. A complete description of the physical and chemical properties of FAVOR® PAC are confidential and are not for public disclosure. This information was provided in Chapter III of FAP 2B4323 in support of 21 C.F.R. 17712.11.

a. Chemical Name

The indirect food additive consists of:

> a grafted copolymer of crosslinked polyacrylic acid sodium salt polymer with polyvinyl alcohol.

The *Chemical Abstracts* name for the indirect food additive is:

> 2-Propenoic acid, polymers with N,N-di-2-propenyl-2-propen-1-amine and hydrolyzed polyvinyl acetate, sodium salts, graft.

b. Common or Trade Names

The common name for the indirect food additive is "superabsorbent polymer" or "SAP." The trade name for the indirect food additive is FAVOR® PAC.

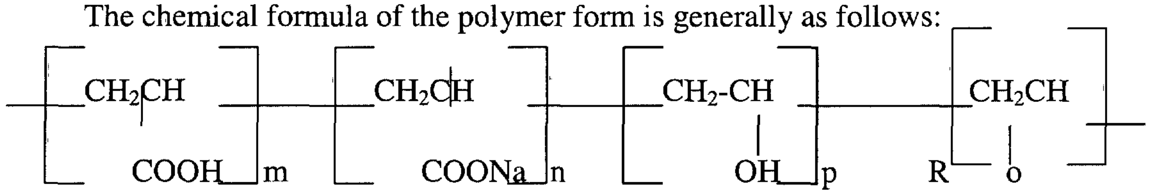
The indirect food additive is manufactured in a formulation known as FAVOR® PAC 100.

c. Chemical Abstracts Service (CAS) Registry Number

The *Chemical Abstracts Service* registry number for the indirect food additive is 166164-74-5.

d. Structural Formula

The chemical formula of the polymer form is generally as follows:



acrylic acid
acrylic acid PVOH crosslinker
sodium salt

R: crosslinking agent

e. Molecular Weight

Current technology available for molecular weight determinations is insufficient for molecular weight analysis of FAVOR® PAC superabsorbent products. Typical molecular weight determinations require sample preparation procedures that provide a homogeneous (dissolved) solution of the compound. FAVOR® PAC products are highly crosslinked polymers with a three dimensional network that is not soluble in any known solvent. Due to the crosslinking network, the determination of the exact molecular weight is not possible with today's available technology. Each separate FAVOR® PAC particle represents essentially only one molecule with an extremely large molecular weight. Therefore, FAVOR® PAC polymer products can be safely said to exceed ten (10) million Daltons.

f. Physical Description

FAVOR® PAC is a white granulate with residual amounts of moisture [2.2 - 4.9 % (w/w)]. Upon addition of aqueous fluid it starts to swell, yielding a gel-like suspension. Uptake of aqueous fluid is in the range of approximately 70 - 200 grams of fluid per gram of polymer, depending upon the fluid. The pH of FAVOR® PAC is 5.8 - 6.0.

g. Impurities

Impurities that may occur in the final product include (1) the residual monomer and crosslinker, (2) the by-products formed by side reactions of catalysts, (3) polymerized water soluble components, and (4) heavy metals.

Residual monomer and crosslinker: During the manufacturing process residual amounts of free acrylic acid are routinely measured in accordance with standardized methods. Residual crosslinker is measured periodically. The mean values (x) of the free acrylic acid and crosslinker are presented in *Attachment A*.

By-products formed by side reactions of catalysts: Due to extreme temperatures used in the manufacture of FAVOR® PAC, impurities resulting from by-products formed in side reactions of the catalysts are unlikely. Where methods exist to measure the possible by-products that may be formed from the side reactions, no values above the limits of detection have been measured.

Polymerized Water Soluble Components: Polymerized acrylic acid up to molecular weights of 10^6 are soluble in watery solvents and can therefore be extracted from the crosslinked insoluble polymer. The amount of soluble components rages from 3 to 5 percent by weight, depending on the modification and specific test method used.

Heavy Metals: Stockhausen has evaluated FAVOR® PAC for the presence of heavy metals. Only one element, Iron, has been measured above the limits of detection. Its occurrence is due to impurities contained in the raw materials, as well as the manufacturing process.

6. Introduction of substances into the environment:

a. **Introduction of substances into the environment as a result of manufacture:** There are no extraordinary circumstances pertaining to the manufacture of FAVOR® PAC.

b. **Introduction of substances into the environment as a result of use:** Little or no introduction of the SAP into the environment will result from its use because it is completely incorporated into absorbent pads and essentially all of it is expected to remain with these materials throughout the use of the pads in the manufacture of food packaging and through use by consumers.

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c. **Introduction of substances into the environment as a result of disposal:**

(i) **Landfills:** We expect only very low levels of the SAP and other substances to leach from the food packaging materials in landfills. Moreover, even if a very small amount of the food contact substance migrates from the food packaging materials in landfills, we expect only extremely low quantities to enter the environment. This finding is based on the Environmental Protection Agency (EPA) regulations governing municipal solid waste landfills. In addition, introducing these substances into the environment will not threaten a violation of the EPA regulations in 40 C.F.R. part 258 that pertain to landfills.

(ii) **Combustion:** The SAP is composed predominately of carbon, hydrogen, and oxygen elements commonly found in municipal solid waste. The complete combustion of the SAP in a properly functioning incinerator will produce only carbon dioxide and water. Since the market volume of the SAP is a small fraction of the municipal solid waste generated and disposed in the United States, adding it to waste that is burned will not alter significantly the emissions from the municipal waste combustors. Due to the nature of the combustion products and their low levels compared to the amounts currently generated by municipal waste combustors, we do not expect that the combustion products from incinerating the SAP will cause a violation of applicable emissions laws and regulations.

6. **Fate of emitted substances in the environment:**

The super absorbent polymer FAVOR® PAC can enter the environment in three different forms: as a granulate, as a gel, and after extraction in a watery environment, as soluble components.

a. **The Granulate**

There is no significant environmental exposure from the granulate.

b. **The Gel**

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When the dry granulate are exposed to aqueous fluids a gelled material will result due to uptake of the fluid by the granulate.

In soil and possibly in landfills the gel slowly undergoes irreversible shrinkage. Polyacrylate polymers function in an anionic exchange capacity where the sodium ion is replaced predominantly by calcium and magnesium ions and other multivalent cations. Exchange of ions leads to a sharp reduction of the water retention capacity and hence the potential of any water soluble components to leach out of the polymer matrix.

The gel itself appears to be stable against microbial attack. UV-light and some heavy metals, such as iron, appear to be able to destroy the gel, disintegrating it into soluble components. The practical relevance of these mechanisms for soil is still not clear.

c. Soluble Components

When excess water is added to the polymer soluble components can migrate out of the polymer matrix. Preliminary data indicate that biological degradation of the water soluble components is possible. *See Attachment D.*

Suspended polymer and soluble components of SAP were tested with respect to their behavior in waste water plants (*See Attachment E*). It was found that 97% of the polymer was retained in the solids and effluent releases were only minimal. This indicates that the elimination rate due to precipitation and adsorption is very high.

Furthermore, behavior of soluble components of SAP in sand with respect to migration and adsorption was examined (*See Attachment F*). Some migration dependent upon molecular weight was indeed observed, but most of the polymer was retained in the sand.

Additional data about desorption, absorption and migration in soil will be available in the future, due to an ongoing study program involving radiolabelled superabsorbent polymer. This study will give a very clear picture of the actual behavior of all aspects of SAP in the ecosystem.

8. Environmental effects of released substances

a. Air

Air emissions are controlled by air scrubber devices that have a design removal rate of over 98 percent. Therefore, substances are not released to air during the manufacture of FAVOR® PAC.

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b. Water Ecosystems

No adverse effects to water organisms are expected under realistic environmental exposure conditions. Tests performed to evaluate FAVOR® PAC's effects on water organisms are described below. It is important to note that water extracts can only be tested technically, as there is no specific analytical means to determine the water extracted components of the carbon content (referred to as *"mg C/l"*).

1. Effects on Growth of Water Organisms

a. Chronic effects to the growth behavior and propagation of the microorganism *Pseudomonas putida* were determined with a watery extract of FAVOR® PAC. No inhibitory effects of growth behavior of the bacteria were observed; *i.e.*, cytotoxic, cytostatic or biocidal effects are not to be expected. The EC_{50} value for half maximum propagation is higher than the highest concentration tested, *i.e.*, 698 *mg* C/*l* which equals 6 *g* polymer/*l*. Therefore, no critical effects to bacteria are expected under relevant disposal conditions. *Chronic Bacterial Toxicity of Favor PAC 990 on Pseudomonas putida*, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment G.*

b. Growth behavior of the single cellular algae *Scenedesmus subspicatus* was determined with a watery extract of FAVOR® PAC. Inhibition of growth was observed at all concentrations tested. The EC_{50} value which defines half maximum growth is approximately 50 *mg* C/*l* which equals 0.5 *g* polymer/*l*.

The observed moderate toxicity is thought to be of minor practical importance under realistic environmental exposure conditions. *Chronic Algae Toxicity of Favor PAC 990 on Scenedesmus subspicatus,* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment H.*

c. Cells of the ciliate *Tetrahymena pyriformis* were incubated for 48 hours with a watery extract of FAVOR® PAC. At low concentrations of 30 - 60 *mg* C/*l*, no negative effects on growth behavior were observed; higher concentrations of 250 - 500 *mg* C/*l* led to a reduction in the growth rate but no biocidal effects to the point that the cells were killed. The EC_{50} value for half maximum cell propagation is greater than the highest concentration tested, *i.e.,* 500 *mg* C/*l* which equals 6 *g* polymer/*l*. *Chronic Ciliate Toxicity of Favor PAC 990 on Tetrahymena pyriformis*, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment I.*

2. Cytotoxic Effects

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a. Cytotoxic effects and inhibition of reproduction of the water polyp *Hydra litoralis* were determined by exposure to a watery extract of FAVOR® PAC for 14 days. At concentrations of 12.5 - 50 *mg* C/*l*, no cytotoxic effects were observed, but reproduction rates were reduced; higher concentrations of 100 - 200 *mg* C/*l* led to cytotoxic symptoms and a greater reduction in reproduction. The reproduction rate in comparison to the control was reduced in each concentration tested. The EC_5 value, defined as the concentration of the test substance which restricts the reproduction rate to about 5%, is between 10 and 15 *mg C/l* which equals 0.18 - 0.26 *g* polymer/*l*. Correspondingly, the EC_{50} value, defined as a reduction of reproduction to about 50%, is between 70 and 78 *mg C/l*, which equals 1.23 - 1.37 *g* polymer/*l*. *Hydra Reproduction Test of Favor PAC 990 on Hydra litoralis*, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment J.*

The observed inhibition of reproduction is thought to be of minor practical importance when realistic environmental exposure conditions are taken into consideration. Laboratory for Toxicology and Ecology, Stockhausen (1991).

b. Acute effects on the immobilization of the daphnids *Daphnia magna* were determined with a watery extract of FAVOR® PAC. At low concentrations of 12.5 - 150 *mg C/l*, none of the daphnids were affected. The EC_{50} value after 48 hours is approximately 175 *mg C/l* which equals 3 *g* polymer/*l*. *Acute Daphnia Toxicity of Favor PAC 990 on Daphnia magna,* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment K.*

c. Adverse chronic effects on the reproduction of the daphnids *Daphnia magna* were determined with watery extracts of FAVOR® PAC. At concentrations of 25 *mg C/l*, a small increase of the reproduction rate could be determined; higher concentrations of 75 - 100 *mg C/l* led to a reduced reproduction rate and an increase in the number of very small and dead neonates. The EC_{50} value, defined as that concentration which reduces the reproduction rate by 50% over a time period of 21 days, is approximately 160 *mg C/l* which equals to 3.2 *g* polymer/*l*. *Daphnia Reproduction Test of Favor PAC 990 on Daphnia magna,* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment L.* Therefore, FAVOR® PAC will have no critical deleterious effects on the swimming ability and no negative influence on the reproduction rate of daphnids under relevant environmental exposure conditions.

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3. *Acute Effects to Fish*

To determine acute lethal effects to fish, the cold water species *Leuciscus idus* (golden orf) and the warm water species *Brachydanio rerio* (zebra fish) were exposed to watery extracts of FAVOR® PAC for 96 hours.

a. Golden orfs: At concentrations of 40 - 160 *mg* C/*l*, no deaths were observed, while 30% of the fish exposed to 320 *mg* C/*l* died. The LC_{50} value, which defines the median lethal concentration after 96 hours, is greater than 320 *mg/l*, which equals 5.5 *g* polymer/*l*, for golden orfs. *Acute Fish Toxicity of Favor PAC 990 on Leuciscus idus (golden orf),* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment M.*

b. Zebra fish: At concentrations of 40 - 160 *mg* C/*l*, no deaths were observed, while 90% of the fish exposed to 320 *mg* C/*l* died. The LC_{50} value for zebra fish, which defines the median lethal concentration after 96 hours, is approximately 250 *mg/l*, which equals 4.3 *g* polymer/*l*. *Acute Fish Toxicity of Favor PAC 990 on Brachydanio rerio (Zebra fish),* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment N.*

4. Chronic Effects to Fish

a. Golden orfs: *Leuciscus idus* were exposed to water extracts of FAVOR® PAC over 14 days. None of the concentrations to which the fish were exposed caused death or toxic symptoms. The LC_{50} value for chronic exposure is 300 *mg C/l* which equals 4.98 *g* polymer/*l*. *Chronic Fish Toxicity of Favor PAC 990 on Leuciscus idus (golden orf),* Laboratory for Toxicology and Ecology, Stockhausen (1992). *See Attachment X.*

b. Zebra fish: *Brachydanio rerio* (zebra fish) were exposed to watery extracts of FAVOR® PAC over a time period of 28 days. No deaths were observed at levels up to 150 *mg* C/*l* which equals 2.5 *g* polymer/*l*. The LC_{50} value for the prolonged toxicity test with zebra fish is 250 *mg* C/*l*, which equals 4 *g* polymer/*l*. *Chronic Fish Toxicity of Favor PAC 990 on Brachydanio rerio (Zebra fish),* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment O.*

Therefore, FAVOR® PAC has to be regarded as essentially non-toxic to fish.

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5. Effects on Germination and Development

Adverse effects on germination and development of germs of the cress *Lapidium sativum* in water were determined after 5 days in a watery extract and in the gelled form of FAVOR® PAC. At low concentrations of 50 - 100 *mg* C/*l*, which equals 0.75 - 1.5 *g* polymer/*l*, no negative effect on the root length, the dry weight or the bonity of the seedlings was observed; concentrations of 200 - 500 *mg* C/*l* of the extract and 10 *g/l* of the gel led to inhibition of root growth and weight development. The EC_{50} value, defined as the concentration of the test substance which reduces the growth of the germinating plants by 50%, is 145 *mg* C/*l* which equals 2.2 *g* polymer/*l*. *Cress Germination Test of Favor PAC 990 on Lapidium sativum,* Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment P.*

The observed slight phytotoxic effect is thought to be due to suffocation of the plants and to be of no practical importance, when realistic environmental exposure conditions are taken into consideration.

As can be seen from the data (a summarized compilation is enclosed in *Attachment Q*, the extracts of the FAVOR® PAC are essentially non-toxic if the calculated PEC value for surface water is taken into consideration. The safety factor is at least in the order of 2 x 105 to 5 x 106 if the appropriate no observed effect levels/concentrations (NOEL/C) of *Attachment Q* are used for calculation.

c. Terrestrial Ecosystems

Testing of the FAVOR® PAC in soil was executed with the polymer in a gelled state. The following tests were performed:

1. Soil

The percentage mortality of the earthworm *Eisenia foetida* exposed to FAVOR® PAC over a time period of 14 days was determined. The test soil was mixed with 200 *g* of FAVOR® PAC per 10 *kg* of dry soil.

Percentage mortality was 31% after 14 days and, therefore, the LC_{50} value for half maximum mortality is greater than 20 *g/kg*.

Taking realistic exposure conditions into account, FAVOR® PAC is regarded to be non-toxic to earthworms. *Favor PAC 990 Determination of Acute Toxicity to Earthworms (Limit Test)* (1990). *See Attachment R.*

2. Birds 000227

Acute toxicity of FAVOR® PAC to the bird *Colinus virginianus* (bobwhite quail) was determined by administering a single oral application of FAVOR® PAC and observing the birds for 14 days. As no deaths or adverse clinical effects were observed at a dose level of 2,000 *mg/kg* body weight the LD_{50} value for half maximum lethality is greater than 2,000 *mg/kg*. *Favor PAC 990 - An Investigation of the Acute Toxicity of a Superabsorbent Polymer to Bobwhite Quail* (1990). *See Attachment S*

Therefore, no critical effects to birds are expected under relevant waste conditions.

3. **Plants**

a. Phytotoxic effects of FAVOR® PAC upon the emergence and growth of seedlings of *Triticum aestivum* (winter wheat) and *Phaseolus aureus* (mung bean) in soil were determined by mixing the test substance with the soil. Target concentrations were 0, 5.0, 10. and 20.0 *g/kg*$^{-1}$. After 14 days, no phytotoxic effects were observed in the winter wheat, including death of seedlings due to rotting and failure of cotyledons to open. Root growth was stunted at the highest test concentrations; the LC_{50} value for emergence was greater than 20 *g/kg*$^{-1}$; the EC_{50} for growth rate based on weight at termination was 8.80 *g/kg*$^{-1}$.

In mung beans, the LC_{50} value for emergence is 9.2 *g/kg*$^{-1}$; the EC_{50} for growth rate based on weight at termination was 11.85 *g/kg*$^{-1}$. Phytotoxic effects on mung beans include the death of seedlings due to rotting and failure of cotyledons to open. This is thought to be due to physical effects by creating a very moist environment around the roots, leading to rotting of the mung bean seedlings. *Phytotoxic Effects of a Cross-Linked Homopolyacrylate* (1991). *See Attachment T.*

Therefore, under appropriate use conditions no critical deleterious effects are expected.

b. Phytotoxic effects of FAVOR® PAC on the emergence and growth of seedlings of the following plants were determined with application rates of 0, 0.2, 2.0 and 20.0 g/kg soil:

Phaseolus aureus (mung bean), *Lactuca sativa* (lettuce), *Lapidium sativum* (cress), *Lycopersicon esculentum* (tomato) and *Cucumis sativus* (cucumber).

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Germination was not effected in lettuce, tomato and cucumber up to the highest concentration and for mung bean and cress in the LC_{50} values for emergence is 9.2 and 4.1 *g/kg*, respectively. Growth rate of the seedlings was reduced in all species and the EC_{50} values for half maximum growth rate varies between 10.1 and 0.22 *g/kg*. Test material was observed to adhere to the roots as jelly-like particles at 2.0 and 20.0 *g/kg* concentration. The observed phytotoxic effects on the seedlings may be due to different sensitivity of the species to the very moist environment around the roots and are thought to be of minor practical importance when realistic environmental exposure conditions are taken into consideration. *See Attachment U.*

Taking into consideration the PEC estimated above, either no safety factors can be calculated because of any lack of toxicity for bacteria and quails or calculation is not possible because of unrealistic exposure conditions.

9. Use of resources and energy

Precise data regarding the sue of resources and energy related to FAVOR® PAC are not available. FAVOR® PAC, however, is not required if the proposed food additive is intended for the same use as another additive already in use (i.e., fluff pulp), and therefore will not materially change the potential use of the packaging material to which it is added. Cellulose Fluff (wood pulp) is presently used in food packaging. The FAVOR® PAC superabsorbent polymer is intended as an adjunct to or replacement for the fluff.

The use of the superabsorbent FAVOR® PAC significantly improves absorbent pad performance in that higher amounts of fluid even under high pressure are taken up by the SAP reinforced pads as compared to conventional types. Due to the enhanced absorption and retention of the new structure, fewer pads will be necessary per package of poultry, meat, fruits, vegetables, or fish. This means that the total volume of disposed soaker pads could be reduced by the introduction of the new food additive FAVOR® PAC.

10. Mitigation measures

Mitigation measures are not required because of FAVOR® PAC's negligible impact on the environment. Therefore, a discussion of mitigation measures is not required.

11. Alternatives to the proposed action

Based on available data, FAVOR® PAC has no significant environmental impacts. Therefore, a discussion of alternatives to the proposed action is not required.

12. List of preparers

Jane Mills Davis, Consultant, Stockhausen, Inc., Greensboro, North Carolina; Bachelor of Science in Chemistry.

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The FDA was consulted regarding the proper format of the EA.

13. Certification

The undersigned official certifies that the information presented is true, accurate, and complete to the best of the knowledge of Stockhausen, Inc.

DATE: October 30, 2002

SIGNATURE:

John McLeod
Title: Sales Manager
Technical Superabsorbant

14. References

Acute Daphnia Toxicity of Favor PAC 990 on Daphnia magna, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment K.*

Acute Fish Toxicity of Favor PAC 990 on Leuciscus idus (golden orf), Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment M.*

Acute Fish Toxicity of Favor PAC 990 on Brachydanio rerio (Zebra fish), Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment N*

Chronic Bacterial Toxicity of Favor PAC 990 on Pseudomonas putida, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment G.*

Chronic Algae Toxicity of Favor PAC 990 on Scenedesmus subspicatus, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment H.*

Chronic Ciliate Toxicity of Favor PAC 990 on Tetrahymena pyriformis, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment I.*

Chronic Fish Toxicity of Favor PAC 990 on Brachydanio rerio (Zebra fish), Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment O.*

Cress Germination Test of Favor PAC 990 on Lapidium sativum, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment P*

Daphnia Reproduction Test of Favor PAC 990 on Daphnia magna, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment L.*

Favor PAC 990 Determination of Acute Toxicity to Earthworms (Limit Test) (1990). *See Attachment R*

Favor PAC 990 - An Investigation of the Acute Toxicity of a Superabsorbent Polymer to Bobwhite Quail (1990). *See Attachment S*

Hydra Reproduction Test of Favor PAC 990 on Hydra litoralis, Laboratory for Toxicology and Ecology, Stockhausen (1991). *See Attachment J.*

Leuciscus idus (golden orf), Laboratory for Toxicology and Ecology, Stockhausen (1992). *See Attachment X.*

Phytotoxic Effects of a Cross-Linked Homopolyacrylate (1991). *See Attachment T.*

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15. Attachments

The list of attachments is incorporated by reference from FAP 2B 4323. There are no additional attachments that are not in FAP 2B 4323.

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